BULLETIN OF THE IMPERIAL INSTITUTE

A RECORD OF PROGRESS RELATING TO AGRICULTURAL, MINERAL AND OTHER INDUSTRIES, WITH SPECIAL REFERENCE TO THE UTILISATION OF THE RAW MATERIALS OF THE DOMINIONS, COLONIES AND INDIA

VOL. XXIV. 1926

LONDON
JOHN MURRAY, ALBEMARLE STREET, W.

ERRATA

Page 201, line 2 from bottom, *for* tons *read* kilos.
,, 202, lines 8 and 16, *for* tons *read* kilos.
,, 480, line 10, for *filimentosa* read *filamentosa.*

Printed in Great Britain by
Hazell, Watson & Viney, Ld., London and Aylesbury.

BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XXIV. 1926

CONTENTS

CONTENTS

CONTENTS

PART B.—MINERAL RESOURCES

CONTENTS

LIST OF ILLUSTRATIONS

CYPRUS SILK FILATURE

GINGER: ITS CULTIVATION, PREPARATION AND TRADE

THE IMPERIAL INSTITUTE

South Kensington, S.W.7

GENERAL INFORMATION

THE Imperial Institute was founded as the Empire Memorial of the Jubilee of Queen Victoria. Its principal object is to promote the development of the commercial and industrial resources of the Empire.

Under the provisions of the Imperial Institute Act of 1925, the Institute has been reorganised and placed under the control of the Department of Overseas Trade. The Parliamentary Secretary of that Department is the responsible Minister and is Chairman of the Board of Governors. This body consists of the High Commissioners of the Dominions and India, representatives of the Colonial Office and of certain other Government Departments, and the Crown Agents for the Colonies, with additional members representing scientific and commercial interests. The Board has appointed Lieut.-Gen. Sir William Furse, K.C.B., D.S.O., as Director of the Institute.

On July 1, 1925, the Imperial Mineral Resources Bureau was amalgamated with the Imperial Institute, and the fifteen Advisory Technical Committees of the Bureau have been reconstituted in the reorganised Institute.

For the purpose of carrying on the work of the Institute two principal Departments have been established, viz. a Plant and Animal Products Department and a Mineral Resources Department. An Advisory Council for each of these groups of products has been appointed, Sir David Prain, C.M.G., C.I.E., F.R.S., being Chairman of the Plant and Animal Products Council, and Sir

Richard Redmayne, K.C.B., Chairman of the Mineral Resources Council.

A number of Advisory Technical Committees consisting of authorities on the various groups of raw materials co-operate in the work of the Institute, in association with the Advisory Councils, and a close touch is maintained with producers, users, merchants and brokers. Valuable help can thus be given by the Institute to persons interested in the development of the resources of raw materials throughout the Empire.

Intelligence.—The Institute maintains a special service for dealing with enquiries relating to the sources, production, uses and marketing of raw materials and for collecting and disseminating general and statistical information on these subjects. This service is available for the use of individuals and firms, as well as of Government Departments, without charge.

Investigations.—The laboratories of the Institute are specially equipped for the chemical and technical examination of raw materials of all kinds. Full reports are furnished on the composition, uses and value of materials submitted. By its close association with the users of raw materials, the Institute is able to arrange large scale trials of promising materials when necessary.

Special analyses and investigations are undertaken for firms or private persons in any part of the Empire on payment of appropriate charges. Applications for such investigations should be addressed to the Director.

Investigations on plantation rubber are conducted at the Institute in connection with the Ceylon Rubber Research Scheme.

Library.—The Library of the Institute contains a large collection of Colonial, Indian and other works of reference and is regularly supplied with the more important reports and other publications of government departments in Great Britain, the Dominions, Colonies and India, and most foreign countries. More than 500 serial publications, mainly of a scientific or technical character, are also regularly received.

The library is available (free of charge) for the use of enquirers between the hours of 10 a.m. and 5.30 p.m. on week-days (10 a.m. to 1 p.m. on Saturdays).

Statistical Section.—This section is concerned with the collection of statistics for the use of other Departments of the Institute.

Publications.—The BULLETIN OF THE IMPERIAL INSTITUTE contains records of the principal investigations conducted for the Dominions, Colonies and India at the Imperial Institute, and special articles, notes and abstracts, chiefly relating to progress in tropical agriculture, the development of mineral resources, and the industrial utilisation of all classes of raw materials.

Other publications of the Institute include a series of handbooks dealing with the Commercial Resources of the Tropics, with special reference to West Africa; Reports of the Indian Trade Inquiry; a series of Selected Reports on Investigations at the Institute; Monographs dealing with the Mineral Industry of the British Empire and Foreign Countries as well as a statistical series relating thereto; and a series of volumes on the Mining Laws of the British Empire and Foreign Countries.

Public Exhibition Galleries.—These galleries are for the purpose of maintaining in London a permanent exhibition illustrative of the natural resources, scenery and life of the people in the Dominions, India and other overseas countries of the Empire. The exhibits in the galleries have hitherto largely consisted of samples of raw products of vegetable, animal and mineral origin, which, although representing materials of vast importance to commerce, have an interest for but a limited number of the general public. In view of the need of modernising the methods of displaying exhibits, and of the large amount of material obtained from Wembley at the close of the British Empire Exhibition, it has been necessary to close the galleries for the time being to enable a new scheme of arrangement to be carried into effect. Advantage has been taken of the opportunity thus afforded to install new lighting and

heating systems and to carry out a scheme of redecoration. When the new arrangement is completed, and the galleries are reopened, the exhibits will include a number of dioramas, illuminated models, transparencies and other forms of pictorial representation which appeal to children and to the general public. A number of exhibits of this type were received from Wembley, and others on the same lines are now being provided for various Courts. These will be supplemented by exhibits of new and important commercial products arranged with a view to attract and instruct the ordinary visitor. For commercial and scientific enquirers a complete range of samples of raw products will be available for inspection in other rooms of the Institute.

It is anticipated that under the new scheme the exhibition galleries will become far more popular than they have hitherto been and that, for educational and propaganda purposes, they will make a more direct appeal to the general public.

Imperial Institute Exhibit at the British Industries Fair. At the invitation of the Department of Overseas Trade, the Imperial Institute arranged an exhibit at the British Industries Fair which was held in London from Feb. 15 to Feb. 26, 1926. The exhibit consisted of specimens of Empire raw materials, investigated by the Institute, which would be suitable for use in the various industries represented at the Fair. It comprised the following sections: timbers, paper-making materials, cotton and fibres, silk, essential oils, gums and resins, glass-making materials, pottery-making materials, brick, tile and fireclays, and the rare earth industry.

Considerable interest was taken in the exhibit by manufacturing firms and others, and a large number of enquiries were received for special information regarding the products shown and their commercial possibilities.

IMPERIAL INSTITUTE

Trustees

Board of Governors

President: ARTHUR MICHAEL SAMUEL, M.P. (Parliamentary Secretary to the Department of Overseas Trade).

Representatives of the Dominions, India, etc.

Canada	The Hon. PETER LARKIN (High Commissioner).
Australia	The Rt. Hon. Sir JOSEPH COOK, G.C.M.G. (High Commissioner).
New Zealand	*Col. the Hon. Sir JAMES ALLEN, G.C.M.G., K.C.B. (High Commissioner).
South Africa	J. S. SMIT (High Commissioner).
Newfoundland	Captain VICTOR GORDON, C.M.G. (High Commissioner).
India	Sir ATUL CHATTERJEE, K.C.I.E. (High Commissioner).

Representatives of Government Departments

Treasury	*C. L. STOCKS.
Board of Trade	P. W. L. ASHLEY, C.B.
	Dr. F. H. HATCH, O.B.E., M.I.C.E. M.I.M.M. (for Mines Department).
Colonial Office	The Rt. Hon. Lord ISLINGTON, G.C.M.G., D.S.O.
	*Sir GILBERT GRINDLE, K.C.M.G., C.B.
	*P. H. EZECHIEL, C.M.G. (for Crown Agents).
Ministry of Agriculture and Fisheries	Sir DANIEL HALL, K.C.B., F.R.S.
Department of Overseas Trade	Sir WILLIAM CLARK, K.C.S.I., C.M.G. (*Vice-President of the Board*).
Department of Scientific and Industrial Research	Sir FRANK HEATH, K.C.B.

* Members of Managing Committee.

Representatives of Scientific and Commercial Interests

Royal Society . . .	Sir JOHN FARMER, M.A., D.Sc. (Oxon.), LL.D., F.R.S.
Formerly Governors of the Mineral Resources Bureau	WALLACE THORNEYCROFT, J.P., F.R.S.E., M.I.M.E.
	W. FORSTER BROWN, M.I.C.E., M.I.M.E.
	H. F. MARRIOTT, A.R.S.M., M.I.C.E., M.I.M.M.
President of the Association of British Chambers of Commerce . . .	*STANLEY MACHIN, J.P.
Federation of British Industries	A. JOHNSTON.
Royal Botanic Gardens, Kew (Director) . . .	Dr. A. W. HILL, M.A., F.R.S., F.L.S.
Imperial Institute Advisory Councils (Chairmen). .	*Lieut.-Colonel Sir DAVID PRAIN, C.M.G., C.I.E., F.R.S., F.R.S.E., F.L.S. (Plant and Animal Products).
	*Sir RICHARD REDMAYNE, K.C.B., M.Sc., M.I.C.E., M.I.M.E., M.I.M.M., F.G.S. (Mineral Resources).

Secretary : Major O. J. F. KEATINGE, D.S.O.

Advisory Council on Plant and Animal Products

Chairman : Lieut.-Colonel Sir DAVID PRAIN, C.M.G., C.I.E., F.R.S.

Colonel the Hon. Sir JAMES ALLEN, G.C.M.G., K.C.B.
A. CHASTON CHAPMAN, F.R.S.
The Rt. Hon. Sir JOSEPH COOK, G.C.M.G.
Sir JAMES CURRIE, K.B.E.
Sir EDWARD DAVSON.
Sir JOHN FARMER, M.A., D.Sc. (Oxon.), LL.D., F.R.S.
Captain VICTOR GORDON, C.M.G.
Dr. A. W. HILL, M.A., F.R.S., F.L.S.
H. A. F. LINDSAY, C.B.E., representing the High Commissioner for India.
H. ERIC MILLER.
Sir EDWARD ROSLING.
H. D. SEARLES-WOOD, F.R.I.B.A.
Sir FRANK WARNER, K.B.E.
ALFRED WIGGLESWORTH.
A. W. WILSON, representing the High Commissioner for Canada.

Secretary : H. BROWN.

Advisory Council on Mineral Resources

Chairman : Sir RICHARD REDMAYNE, K.C.B., M.Sc., M.I.C.E., M.I.M.E., M.I.M.M., F.G.S.

Vice-Chairman : The Rt. Hon. Lord MORRIS, K.C.M.G., K.C., representing the High Commissioner for Newfoundland.

Vice-Chairman : Admiral Sir EDMUND SLADE, K.C.I.E., K.C.V.O.

* Members of Managing Committee.

W. Forster Brown, M.I.C.E., M.I.M.E.
Dr. C. Camsell, representing the High Commissioner for Canada.
P. M. Dearle.
J. W. Evans, C.B.E., D.Sc., LL.D., F.R.S., F.G.S.
Professor J. W. Gregory, D.Sc., F.R.S.
Sir Robert Hadfield, Bart., F.R.S.
Dr. F. H. Hatch, O.B.E., M.I.C.E., M.I.M.M.
Sir Herbert Jackson, K.B.E., F.I.C., F.R.S.
Hugh F. Marriott, A.R.S.M., M.I.C.E., M.I.M.M.
William S. Robinson, representing the High Commissioner for Australia.
W. Thorneycroft, J.P., F.R.S.E., M.I.M.E.
Professor Thomas Turner, M.Sc., F.I.C., A.R.S.M.

Secretary: Major W. M. Henderson-Scott, A.R.S.M., F.G.S., M.I.M.M.

Administration

Director: Lt.-Gen. Sir William Furse, K.C.B., D.S.O.

Principal, Plant and Animal Products Department: H. Brown.

Principal, Mineral Resources Department: Major W. M. Henderson-Scott, A.R.S.M., F.G.S., M.I.M.M.

Secretary: Major O. J. F. Keatinge, D.S.O.

PART A.—PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial, and Indian Governments

---

TIMBERS FROM NIGERIA

THE commercial possibilities of a number of Nigerian timbers were investigated a few years ago by the Imperial Institute Advisory Committee on Timbers, and subsequently five of the more promising woods were submitted to complete examination in order to determine their mechanical properties and working qualities (see this BULLETIN, 1920, **18**, 199, and 1923, **21**, 444).

Further specimens of Nigerian woods were forwarded recently to the Imperial Institute by the Government of Nigeria with a request that their possibilities for joinery and furniture manufacture might be ascertained.

The specimens represented the following timbers:

1. Abura (*Mitragyna macrophylla*).
2. Afara (*Terminalia superba*).
3. Oro (*Irvingia Barteri*).
4. Arere (*Triplochiton nigericum*).
5. Ogia (*Daniella Ogea*).

In each case the working qualities were determined at the Institute, and the specimens were submitted to the Advisory Committee for their opinion as to the suitability of the timbers for the above-mentioned purposes.

The following notes on the trees yielding the timbers may be of interest.

1. *Mitragyna macrophylla.*—Nat. Ord. Rubiaceæ. A large tree occurring in swamp forests and along streams in most West African countries. The wood is used locally for canoes, furniture, drums, barrels, etc.

2. *Terminalia superba.*—Nat. Ord. Combretaceæ. A very large tree, sometimes attaining a height of over 150 feet, and found throughout West Africa, where the wood is used for shingles, windows and interior work in buildings. The tree has been tried in mixed plantations in Nigeria and has been found to be of rapid growth.

3. *Irvingia Barteri.*—Nat. Ord. Simarubaceæ. A somewhat slow-growing tree, occurring in the rain forests throughout West Africa. The wood is employed locally in house-building and is said to be impervious to white ants.

The tree has an edible fruit, and the so-called Dika bread or Gaboon chocolate is prepared by crushing the seed-kernels and pressing the material into cakes. The fat from the kernels, if carefully prepared and refined, could be used for edible purposes.

4. *Triplochiton nigericum.*—Nat. Ord. Sterculiaceæ. A typical tree of the mixed deciduous type of West African forest where the rainfall does not exceed 60 in. It is one of the largest West African trees, reaching a height of 150 ft., sometimes with a clear 90 ft. bole and a girth of 20 ft. The large root buttresses are sometimes employed for making doors, and canoes are made from the wood.

5. *Daniella (Cyanothyrsus) Ogea.*—Nat. Ord. Leguminosæ-Cæsalpineæ. A large tree of the heavy rain forest. The bole is straight and round, and often reaches a height of 120 ft. before the first branch. It yields a good gum copal, known as Accra copal or Ogea gum.

No. 1. Abura (*Mitragyna macrophylla*)

A fairly soft, fine and close-grained wood, of moderate weight and plain appearance, with light reddish-brown heartwood and slightly paler sapwood.

Working Tests

(1) *Sawing.*—The wood cuts easily with machine and hand saws.

(2) *Planing.*—The wood planes readily and a smooth surface is obtainable, but a fine cut is necessary on radial-sawn wood as there is a tendency to " pick up " owing to the alternating spiral grain.

(3) *Boring.*—Machine and hand boring tools give good, clean holes.

(4) *Nailing and Screwing.*—Nails and screws can be driven in readily without splitting the wood, and hold firmly.

(5) *Working with Gouge and Chisel.*—The wood cuts easily and cleanly.

(6) *Mortising and Dovetailing.*—The wood cuts well in the mortising machine, but the joints obtainable are not strong as the wood is fairly soft.

(7) *Turning.*—The wood turns readily, giving a fair finish with tools and a smooth surface with glass-paper.

(8) *Glueing.*—Glue adheres firmly to the wood ; joints fail through the wood cleaving.

(9) *Staining.*—The wood takes stain readily and uniformly.

(10) *Polishing.*—The wood absorbs the polish readily, and a number of applications are necessary to obtain good results.

(11) *Varnishing.*—Satisfactory.

Remarks

The Timbers Committee expressed the opinion that Abura wood should be useful locally for light constructional and other work (including joinery and inexpensive furniture) where great strength is not essential, and that it could be used to replace imported soft-woods employed for such purposes. The timber, if clean and sound, might also be suitable as a substitute for cheap mahogany (for which purpose it could be stained), but it is doubtful whether it could compete successfully in the United Kingdom with other timbers marketed as mahogany substitutes.

The mechanical properties and working qualities of the wood of *Mitragyna macrophylla* from the Gold Coast have recently been determined at the Imperial Institute and the results will be published in a future number of this BULLETIN.

No. 2. Afara (*Terminalia superba*)

This timber has already been fully examined at the Institute (*loc. cit.*). It was shown that the wood is of medium hardness and strength, fairly stiff and not unduly brittle. The wood works well with both machine and hand tools.

The Committee described the timber as similar to oak in colour and possessing a straight grain ; it was considered useful for joinery work and for inexpensive furniture. They added that Afara would, no doubt, find many uses in Nigeria where an easily worked timber of moderate strength and good appearance is required. At a sufficiently low price the timber would probably find a market in the United Kingdom.

No. 3. Oro (*Irvingia Barteri*)

A pale greenish-brown, heavy, hard wood of fairly fine and moderately close grain.

Working Tests

(1) *Sawing.*—The wood is fairly difficult to cut with hand or machine saws.

(2) *Planing.*—The wood is hard to plane, but a good smooth surface is obtainable.

(3) *Boring.*—Gimlets and bradawls are difficult to use and the wood splits ; centre bits and twist drills give better results.

(4) *Nailing and Screwing.*—Nails and screws are difficult to drive in, but they hold firmly ; there is a tendency to split.

(5) *Working with Gouge and Chisel.*—The wood cuts fairly readily.

(6) *Mortising and Dovetailing.*—The wood is hard to cut in mortising machine, but clean slots and strong joints are obtainable.

(7) *Turning.*—The wood is rather hard to turn, but shows very little tendency to tear up ; it gives a fairly good surface with tools and a smooth surface with sandpaper.

(8) *Glueing.*—Strong joints are obtainable.

(9) *Staining.*—The wood takes stain fairly well.

(10) *Polishing.*—The wood requires filling, but gives good results.

(11) *Varnishing.*—Satisfactory.

Remarks

The Committee reported that the great weight of this timber would preclude its use for all except the heaviest construction work, for which purpose, however, it would probably be useful. It might also be employed for railway sleepers. The sample examined showed dark grey bands, which, if regularly present, might give the timber an ornamental value. It is, however, regarded as doubtful whether the timber would be worth export.

No. 4. Arere (*Triplochiton nigericum*)

A soft, light, coarse, open-grained wood of yellowish colour and nondescript appearance.

Working Tests

(1) *Sawing.*—The wood cuts very easily with hand and machine saws.

(2) *Planing.*—The wood planes readily, giving a smooth surface ; there is a slight tendency to " pick up " owing to its grain.

(3) *Boring.*—All boring tools cut easily and give fairly clean holes.

(4) *Nailing and Screwing.*—The wood takes nails and screws readily ; they hold fairly well and only those of large diameter cause splitting.

(5) *Working with Gouge and Chisel.*—The wood cuts very easily but tears up.

(6) *Mortising and Dovetailing.*—The wood cuts easily in mortising machine but not cleanly ; there is little strength in the joints.

(7) *Turning.*—The wood cuts readily in the lathe, a fair surface is obtainable with tools, though there is a tendency to tear up ; an excellent finish is obtainable with sand-paper.

(8) *Glueing.*—The wood takes glue well and holds firmly.

(9) *Staining.*—The wood takes stain well.

(10) *Polishing.*—The wood requires filling ; good results are obtainable after a number of applications.

(11) *Varnishing.*—Good results obtainable.

Remarks

This timber is identical for all practical purposes with that of *Triplochiton Johnsoni* (also known as Arere), which was dealt with in the above-mentioned report of the Imperial Institute Advisory Committee on Timbers (this BULLETIN, 1920, **18**, 200). The Committee state that Arere is a soft, light wood without special character and would be of no value for building or constructional purposes in the United Kingdom. It should be useful locally for rough work, but there would probably be much waste in conversion.

No. 5. OGIA (*DANIELLA OGEA*)

The two planks of this wood were of somewhat different appearance and were, therefore, examined separately.

Ogia, I.—A firm wood of moderate weight and good appearance, fairly fine and moderately close-grained, and of a pale yellowish-brown colour.

Working Tests

(1) *Sawing.*—The wood cuts easily with hand and machine saws.

(2) *Planing.*—The wood planes readily and gives a good surface ; there is a slight tendency to " pick up " in radial-sawn wood.

(3) *Boring.*—Good results are obtained with all boring tools.

(4) *Nailing and Screwing.*—Nails and screws can be driven in easily and hold fairly well, but the wood splits readily.

(5) *Working with Gouge and Chisel.*—The wood cuts very easily but tears up badly.

(6) *Mortising and Dovetailing.*—The wood works well in mortising machine, but the joints are of only moderate strength.

(7) *Turning.*—The wood turns well; it gives a good surface with tools and an excellent finish with sand-paper.

(8) *Glueing.*—Good joints are obtainable; the glue holds firmly.

(9) *Staining.*—Good results obtainable.

(10) *Polishing.*—Excellent results obtainable.

(11) *Varnishing.*—The wood takes varnish well.

Remarks

The Committee stated that this wood was of firm texture and would probably season well. They considered that timber of this character might find a market as a useful substitute for mahogany, and that it could be employed for joinery, furniture making, and many general constructional purposes, but would need careful finishing.

Ogia, II.—A pale yellow, firm wood of moderate weight, coarser and more open-grained than Sample I, and having numerous bluish-grey stains.

Working Tests

(1) *Sawing.*—The wood cuts very easily with hand and machine saws.

(2) *Planing.*—The wood planes easily, but there is a slight tendency to " pick up " in radial-sawn wood.

(3) *Boring.*—Fairly clean holes are obtainable with all boring tools.

(4) *Nailing and Screwing.*—The wood takes nails and screws easily and holds them firmly; there is little tendency to split.

(5) *Working with Gouge and Chisel.*—The wood cuts readily but tears up badly.

(6) *Mortising and Dovetailing.*—The wood works easily but roughly in the mortising machine and the joints are rather weak.

(7) *Turning.*—The wood turns readily; it gives a slightly rough finish with tools and a good surface with sand-paper.

(8) *Glueing.*—Good joints are obtainable and the wood holds glue firmly.

(9) *Staining.*—The wood absorbs stain readily.

(10) *Polishing.*—The wood requires filling and numerous applications of polish to obtain satisfactory results.

(11) *Varnishing.*—The wood takes varnish well.

Remarks

The Committee expressed the opinion that timber of this character would not be marketable in the United Kingdom, but that it would probably be useful in Nigeria for rough work, such as the manufacture of packing cases. They added that if the two specimens were both derived from the same tree or from different trees of the same species, it is evident that very careful selection of the sawn timber would be necessary.

WOODS FROM NIGERIA AS PAPER-MAKING MATERIALS

THE five woods from Nigeria dealt with on pp. 1–8 were also examined with a view to determining their possible value for the manufacture of paper-pulp. In each case a representative specimen of the wood was examined chemically, and pulp was prepared from it by treatment with caustic soda under conditions similar to those employed in the production of paper-pulp on a commercial scale.

No. 1. ABURA (*MITRAGYNA MACROPHYLLA*)

Results of Chemical Examination

	Per cent.
Moisture	12·3
Ash	1·3
Cellulose in material as received	45·7
Cellulose expressed on the moisture-free wood	52·0

The ultimate fibres varied from 1·0 to 2·1 mm. in length, with an average of 1·6 mm.

Results of Paper-making Trials

Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp, expressed on material as received.	
Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
		Hours.	°C.		Per cent.	Per cent.
20	4	6	160	11·6	36	35

The above treatment proved quite satisfactory and furnished a well-reduced pulp, which yielded a pale brown paper of fair strength and quality. The pulp did not bleach readily and gave a cream-coloured opaque paper of fair strength.

No. 2. Afara (*Terminalia superba*)

Results of Chemical Examination

	Per cent.
Moisture	10·5
Ash	2·2
Cellulose in material as received	46·2
Cellulose expressed on the moisture-free wood .	51·6

The ultimate fibres varied from 0·9 to 1·9 mm. in length, with an average of 1·2 mm.

Results of Paper-making Trials

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp, expressed on material as received.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
			Hours.	°*C.*		*Per cent.*	*Per cent.*
A	20	4	6	160	12·8	44	39
B	24	4	6	160	14·2	41	37

In the case of Trial A the wood was not sufficiently disintegrated and the pulp did not bleach satisfactorily.

The more severe treatment of Trial B, in which the percentage of caustic soda was increased from 20 to 24 per cent., proved just sufficient to reduce the wood thoroughly and the pulp furnished a fairly strong brown paper. The pulp did not bleach easily and could only be obtained of a dark cream colour; the paper prepared from this pulp was opaque and of fair strength.

No. 3. Oro (*Irvingia Barteri*)

Results of Chemical Examination

	Per cent.
Moisture	10·3
Ash	1·7
Cellulose in material as received	43·7
Cellulose expressed on the moisture-free wood .	48·8

The ultimate fibres varied from 0·8 to 2·5 mm. in length, with an average of 1·5 mm.

Results of Paper-making Trials

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp, expressed on material as received.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
			Hours.	° *C.*		*Per cent.*	*Per cent.*
A	20	4	6	160	12·5	45	41
B	24	4	6	160	13·0	44	40
C	24	4	7	170	14·2	37	33
D	24	4	9	170	15·6	37	32

The pulp produced in Trial A was dark-brown, and contained many coarse particles of imperfectly reduced fibre ; it could not be bleached.

The treatment adopted in Trial B, in which 24 per cent. of caustic soda was employed, effected very little improvement, as the pulp still contained many fragments of insufficiently disintegrated material and could not be bleached.

In Trials C and D, in which digestion was carried on for a longer time and at a higher temperature, somewhat better results were obtained, but in neither case was the material sufficiently disintegrated. On bleaching, the colour of the pulp could only be reduced to a pale brown, although a very strong bleaching solution was employed. The unbleached pulp furnished a soft, rather weak, dark brown paper, whilst the bleached pulp was similar in character, fairly opaque and rather weak. All the specimens of paper obtained from this wood contained small light silvery specks.

No. 4. Arere (*Triplochiton nigericum*)

Results of Chemical Examination

	Per cent.
Moisture	9·7
Ash	1·3
Cellulose in material as received	45·0
Cellulose expressed on the moisture-free wood	50·0

The ultimate fibres varied from 0·9 to 2·1 mm. in length, with an average of 1·4 mm.

Results of Paper-making Trials

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp, expressed on material as received.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
			Hours.	° C.		*Per cent.*	*Per cent.*
A	20	4	6	160	11·8	45	39
B	24	4	6	160	13·6	44	38

The pulp obtained under the conditions of Trial A was not very well disintegrated and could not be bleached satisfactorily. The bleached paper was brownish-cream and of fairly good strength.

Under the more drastic conditions of Trial B a well-reduced pulp was produced which furnished a strong, light brown paper. The pulp bleached with difficulty and gave a strong opaque paper of cream colour and fair quality.

No. 5. Ogia Wood (*Daniella Ogea*)

The two planks of this wood were of somewhat different appearance. They were, therefore, examined separately in order to ascertain whether there was any difference in the paper-pulp obtainable from them.

Ogia I

Results of Chemical Examination

	Per cent.
Moisture	9·7
Ash	0·4
Cellulose in material as received	42·4
Cellulose expressed on the moisture-free wood	46·8

The ultimate fibres varied from 0·7 to 4·0 mm. in length, with an average of 1·5 mm.

Results of Paper-making Trials

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp, expressed on material as received.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
			Hours.	° C.		*Per cent.*	*Per cent.*
A	20	4	6	160	13·8	41	37
B	24	4	6	170	16·9	35	32

Under the conditions of Trial A it was not found possible to obtain a well-reduced pulp.

In the case of Trial B, however, the conditions proved quite satisfactory and gave a well-reduced pulp which furnished a light brown opaque paper of good strength and quality. The pulp did not bleach readily and the bleached paper was opaque and of pale buff colour.

Ogia II

Results of Chemical Examination

	Per cent.
Moisture	11·2
Ash	2·8
Cellulose in material as received	42·8
Cellulose expressed on the moisture-free wood	48·2

The ultimate fibres varied from 1·0 to 2·1 mm. in length, with an average of 1·5 mm.

Results of Paper-making Trials

Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp, expressed on material as received.	
Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
		Hours.	° C.		*Per cent.*	*Per cent.*
24	4	6	170	14·5	39	33

These conditions were just sufficiently severe to yield a well-reduced pulp which furnished a rather soft, dark brown opaque paper of good strength and quality. The pulp did not bleach very readily and the bleached paper was opaque and of pale cream colour.

On the whole, these two specimens of Ogia wood furnished pulp of very similar quality, the chief difference being that the pulp from No. II could be bleached to a pale cream whilst that from No. I could only be bleached to a pale buff colour.

General Remarks

The results of the examination of these five woods are summarised in the following table, which shows in each case the conditions for pulping which furnished the best results. For purposes of comparison the yields of pulp and

the soda consumptions have been calculated on the basis of air-dried woods containing 10 per cent. of moisture.

Wood.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
			Hours.	°C.		*Per cent.*	*Per cent.*
Abura	26	4	6	160	11·9	37	35·5
Afara	24	4	6	160	14·2	41	37
Oro	24	4	9	170	15·6	37	32
Arere	24	4	6	160	13·5	44	38
Ogia I	24	4	6	170	16·8	34·5	31·5
Ogia II	24	4	6	170	14·5	39·5	33·5

All the samples of wood furnished short-fibred pulps, but the average lengths of the ultimate fibres were higher than those from poplar, which is the wood most commonly used in the manufacture of soda pulp.

None of the woods furnished a very high yield of pulp, and, with the exception of Abura, more drastic conditions of digestion had to be employed than are usually found necessary for such materials. Moreover, the pulp obtained from each of the woods bleached with difficulty, the amount of bleaching liquor used being about twice as much as that required for poplar pulp, and in no case was a good white paper produced.

The highest yield of pulp was obtained from the Arere wood, namely 44 per cent., a yield similar to that furnished on a manufacturing scale by poplar. The soda consumption for this wood was, however, somewhat high, and the pulp was difficult to bleach, although it was otherwise of satisfactory quality. A fairly good yield of pulp was also obtained from the Afara wood, but the consumption of soda was even higher than with Arere, and the bleached paper was darker than that obtained from the latter. In other respects these two pulps were rather similar in quality.

The samples of Abura, Oro and Ogia woods furnished rather low yields of pulp. The Abura wood broke down more readily than any of the other four woods and showed a comparatively low soda consumption; the pulp felted well, but bleached with the same difficulty as Arere pulp

to about the same shade, and produced paper of similar character though not quite so strong as Arere paper.

The samples of Oro and Ogia woods did not prove satisfactory as paper-making materials. More vigorous treatment was required to break up these woods than in the other cases, and the consumption of soda was high. Ogia wood, although capable of producing unbleached paper of good strength and quality, furnished a low yield of pulp which was difficult to bleach. In the case of Ogia I the colour of the pulp could only be reduced to a pale buff, but in the second sample, Ogia II, a pale cream-coloured paper was obtained. In the case of the Oro wood the pulp obtained was of inferior quality and could not be bleached.

BAKING QUALITIES OF MESOPOTAMIAN (IRAQ) WHEAT. II

A REPORT was published in this BULLETIN (1924, 22, 284) on seventeen samples of wheat produced in the course of selection experiments at the Government Experimental Farm, Baghdad. It was shown that the flours from these wheats varied somewhat in behaviour in bread-making, and on the whole were comparable to those from Indian wheats. In the United Kingdom the wheats would be used for mixing with Manitoba and Australian wheats.

It was pointed out in the report that the characters of the wheats may change to some extent during their continued cultivation in Iraq, and that the experiments should be carried on for a number of years in order to determine the particular varieties which give the best results after acclimatisation. In this connection the Inspector-General of Agriculture has since informed the Institute that one of the wheats (No. 243), which was found to be inferior for bread-making to most of the other samples, was the direct progeny of " Punjab 17 " wheat, imported into Iraq in 1918. This variety is a beardless wheat, with amber-coloured grain and is very commonly grown in the Punjab. With a view to ascertaining more definitely the effect of cultivating this variety in Iraq over a period of years the Inspector-General forwarded

in 1925 two further samples, one grown in that country continuously for six years, and the other grown from newly imported stock. Together with these he forwarded a sample of Australian wheat which has given good yields, but of which sufficient was not available in 1924 for baking trials. The results of the investigation of the three wheats are given below. As in the case of the earlier samples, the chemical examination of the wheats was conducted in the laboratories of the Institute and milling and baking tests were carried out by Mr. John Kirkland of the National School of Bakery, Borough Polytechnic, London. Explanations of the technical terms used in Mr. Kirkland's report will be found as an appendix to the previous report.

The samples were as follows :

No. 141 *Australian wheat* (*Nyngan No.* 3).—This sample consisted of rather small, light brown grains, fairly soft to fairly hard, and mostly opaque but in some cases translucent. Weight per bushel, 64·3 lb. Weight of 100 grains, 3·90 grams.

No. 220 (*derived from Punjab No.* 17).—This consisted of rather small, light brown grains, mostly semi-translucent, some, however, being opaque ; they varied from fairly soft to hard. Weight per bushel, 64·3 lb. Weight of 100 grains, 3·84 grams.

No. 799 (*derived from Punjab No.* 17).—The grains of this sample were rather small, fairly hard, and of light brown colour ; each grain was partly opaque and partly semi-translucent. Weight per bushel, 62·5 lb. Weight of 100 grains, 3·53 grams.

Results of Analysis

Chemical examination of the samples gave the following results, which are expressed in each case on the wheat as received :

	No. 141. *Per cent.*	*No.* 220. *Per cent.*	*No.* 799. *Per cent.*
Moisture	9·6	9·2	9·9
Ash	1·6	1·9	1·6
Protein (N × 5·7)	10·0	9·1	11·5
Gluten :			
Wet	22·4	20·7	27·2
Dry	7·7	7·2	9·5
Character of gluten	Fairly tough and elastic.	Fairly tough and elastic.	Slightly tougher and less elastic than in Nos. 141 and 220.

These results are of considerable interest in view of the fact that Samples Nos. 220 and 799 both represent the progeny of "Punjab 17" wheat. These two samples differ in the amounts of protein and gluten present, but No. 220 closely resembles the earlier Sample No. 243 from "Punjab 17." As regards the quality of the gluten, that of No. 799 was stronger than that of Nos. 220 and 243.

Results of Baking Trials

Mr. Kirkland furnished the following report on the results of his experiments:

"*No.* 141.—The flour from this wheat is soft and mild in its nature. It is much like that now received in this country from South Australia, but resembles also Victorian flour as imported some 25 years ago. In Australia, it seems, there have been considerable changes in the nature of wheat grown, in the different States, within the last quarter of a century. At the beginning of that period much the strongest flour came from South Australia; slightly softer flour was general in Victoria, while the softest of all the exportable sorts was made in New South Wales. Now the strongest flours come from Victoria, while that from South Australia is softer.

"The No. 141 flour makes a loaf of rather small volume. It is of good colour, and soft and moist to the touch. By itself it would not make satisfactory bread, but it would be excellent as part of a mixture. For mixing purposes the wheat should, therefore, have a good market here, but at a low price because of its deficiency in strength.

"*No.* 220.—This wheat was in a rather dusty condition. The flour from it, 'straight run' grade, makes the least satisfactory loaf of any of the three present wheats. It is quite stable, and not deficient in strength, but the bread made from it is harsh of crumb and flinty of crust. These defects make it unsuitable *by itself* for use in London breadmaking, but it would be adaptable as part of a miller's wheat mixture. Thus, along with No. 141, it would produce a flour that might be mild enough in its nature for breadmaking, although the loaf would not be very large.

"*No.* 799.—The flour from this wheat was really strong; its gluten was tough and stable. This wheat should readily find a market with British millers in competition with strong varieties of Indian wheats, or even to replace strong American or Canadian. The flour gives a large yield of bread, and the loaves are of full volume, but slightly harsh. This defect can be modified, or wholly removed, by a little more fermentation than usual, but it is usual to reduce harshness, as produced by one wheat, by introducing a proportion of softer wheat into the mill mixture, or of softer flour by the baker. It was found that a mixture of 60 per cent. of flour from No. 799 with 40 per cent. of that from No. 141 makes excellent bread, and this wheat (No. 799) is probably the most suitable of the three present samples for the British market. The sample as received was, however, very dusty, and its market value would be reduced by such a condition in commercial shipments."

General Remarks

The results of the present investigation indicate that the Australian wheat represented by Sample No. 141 yields a mild soft flour suitable for mixing with stronger varieties. It was suggested that samples of later crops of this wheat might be forwarded in due course to the Imperial Institute for comparative analysis and baking trials.

As regards Samples Nos. 220 and 799, derived from "Punjab 17," No. 220 closely resembled the previous sample No. 243 from the same stock both in analytical results and baking qualities (see this BULLETIN, 1924, **22**, 286). No. 799, however, was distinctly superior to Nos. 220 and 243 in these respects, indicating that there has been a distinct alteration in the properties of this wheat, from a breadmaking point of view, since its introduction into Iraq.

ARTICLE

KAPOK

A Survey of its Production within the Empire, with Notes on its Cultivation and Uses

The fine, cotton-like fibre known as kapok is now familiar to everyone from its widespread use as a stuffing material in upholstery. The tree which produces it occurs in all the tropical parts of the British Empire, but practically the entire commercial supply of the fibre is obtained from Java. Efforts have been made at different times to start an export trade in kapok from various British countries, but hitherto the only success obtained, and that on a relatively small scale, has been in Ceylon. The Agricultural Department in Malaya has recently taken up the matter energetically, and there seems every reason to expect that commercial supplies will eventually become available from that country. India exports a certain amount of floss under the name kapok, but this, as will be shown later, is principally derived from a different tree from that furnishing Java kapok and is inferior to the latter in quality. Among foreign countries, other than Java, there is a small export of true kapok from the Philippines and Indo-China. In these countries, and also in Siam, the extended cultivation of the tree is being advocated. A certain amount of floss, of diverse origin, is also shipped from South America.

In view of the interest at present being shown in the material, it has been considered opportune to publish the present article dealing with the prospects of kapok production within the Empire, whilst for the benefit of those desiring to grow the tree for the production of the fibre, information has been given as to methods of cultivation and preparation. Specimens of kapok produced in many countries of the Empire may be inspected at the Imperial Institute by those interested.

As indicating the existing demand for kapok, it may be mentioned that in 1924 Java and Madura exported over

15,000 tons, of a total value exceeding 1½ million pounds sterling. Of this quantity nearly 8,000 tons was shipped to the United States; the Netherlands and Australia each took about 3,000 tons and New Zealand and the United Kingdom 500 and 400 tons respectively. There was also in that year an export of about 1,000 tons from the Outer Possessions of the Dutch East Indies, the bulk of which was consigned to the Netherlands. The imports of kapok into the United Kingdom during recent years are shown in the following table:

From	1922.		1923.		1924.	
	Tons.	£	Tons.	£	Tons.	£
India	355	24,578	566	52,486	333	31,783
Other British Possessions	103	7,544	95	10,521	108	9,174
Netherlands	78	7,911	30	3,421	53	7,173
Java	362	36,826	558	69,608	358	44,235
Indo-China	—	32	—	—	113	12,616
Other Foreign Countries	5	470	90	4,697	36	2,657
Total Imports	903	77,361	1,339	140,733	1,001	107,598
Total retained in the United Kingdom	711	58,954	1,113	115,839	690	74,505

The quantities of Indian kapok retained in this country during the three years were 256, 449 and 250 tons, respectively. The corresponding figures for Java kapok were 302, 473 and 288 tons.

In considering the question of extending the production of kapok within the Empire, it is important to bear in mind the possible effect on prices of a large increase in the supplies. In this connection the Imperial Institute is informed by a large firm of kapok merchants that the demand for kapok is increasing, especially in the United States and in certain of the British Dominions, and is likely to continue to do so. They consider that it would be desirable to further the production of the floss within the Empire. Similar views were expressed by an important firm of kapok brokers. As regards the United States it has been stated that mattress manufacturers in that

country cannot "boom" kapok, owing to the difficulty of obtaining supplies. On the whole, therefore, it seems probable that, provided properly prepared material equal to or approaching the Java product in quality can be supplied within the Empire, there should be no difficulty in finding a market for it at good prices.

Before the war the market price of Java kapok in London was about *7d.* to *9d.* per lb. Towards the close of the war the price had risen to as much as *1s. 9d.* It has since fallen somewhat and prime Java kapok is now quoted at *1s. 3½d.* per lb.

Sources and Uses of Kapok

In a large number of plants belonging to widely different families the ripe fruits contain a mass of fine hairs, sometimes attached to the seeds, as in the case of cotton, or arising from the wall of the capsule, as in kapok. These hairs are intended by nature to aid in the distribution of the seeds, but man has adopted them in some cases for his own use. In the most notable of these, cotton, it has been possible by hybridisation, selection and suitable cultivation to produce material which in length, colour, yield and other properties shows a vast improvement over the wild forms. The group of fibres to which kapok belongs, known collectively as flosses or silk-cottons, are usually finer than cotton and exhibit a greater lustre, but they are much weaker than cotton and lack the twist which enables the latter to be spun. Their use, therefore, has hitherto been restricted, and apart from the careful cultivation and preparation of true kapok little has been done to improve their quality.

The term "kapok" has been used for the product of a number of trees, but it should be restricted to the floss of *Eriodendron anfractuosum* (= *E. orientale*, *Ceiba pentandra*), the source of Java kapok. This tree, which belongs to the natural order Bombacaceæ, reaches a great size under natural conditions, but in cultivation is usually seen as a slender tree not exceeding 50 ft. in height. It has a very characteristic appearance, producing horizontal branches arranged in tiers. It sheds its leaves

in the dry season ; the flowers appear just before or at the same time as the new leaves. The fruit is a more or less oblong capsule or pod, about 6 in. long and 2 in. in diameter at its greatest width. As already mentioned the hairs spring from the inner wall of the capsule and are not attached to the seed itself, as in the case of cotton. This is of some importance in connection with the commercial preparation of the floss, as it renders the separation of the seed much more easy, the hairs not having to be forcibly removed from the seed as is necessary in the ginning of cotton.

Flosses allied to true kapok are yielded by many other plants of the Bombacaceæ, the chief of which are species of *Bombax*. The floss exported from India is mainly derived from *B. malabaricum*, and this, when properly prepared, is of good quality, but is not so resilient as good Java kapok. Several species of the genus occur in West Africa, where their floss is used locally, the chief of these, perhaps, being *B. buonopozense*. Other members of the family yielding flosses include *B. Ceiba* and *Chorisia* spp. of South America, *Eriodendron Samauma* of Brazil and *Ochroma Lagopus* of tropical America and the West Indies. Amongst other plants producing silk cottons may be mentioned species of *Asclepias*, *Calotropis gigantea*, *C. procera* and *Gomphocarpus brasiliensis* belonging to the Asclepiadaceæ, *Cochlospermum Gossypium* (Bixaceæ) and the West African rubber tree, *Funtumia elastica* (Apocynaceæ). All these flosses are inferior to true kapok and are unlikely to compete with it in European markets.

The hairs of kapok are cylindrical, from 0·6 to 1·2 in. in length, with very thin cell walls. The cells are full of air and are very light ; they also possess the property of being impermeable to moisture, and on this account are extremely buoyant. For this reason kapok is now used throughout the world for the manufacture of buoys, life-belts and life-saving jackets.

The chief use for kapok is for stuffing cushions, pillows, mattresses and similar articles. It is well adapted for this purpose on account of its lightness, its springy or resilient nature and its non-hygroscopic and non-absorbent

characters. It is in their resiliency that most other flosses are inferior to kapok and therefore of less value for stuffing purposes.

Many attempts have been made to employ kapok as a textile material, but considerable difficulty has been experienced due chiefly to the fact that the fibres have a smooth, slippery surface and, therefore, lack cohesive force. Moreover, kapok is very weak, and yarns made from it are not strong enough for use where any strain is likely to occur. It is stated that the difficulty of spinning the fibre has been surmounted by roughening the surface by chemical treatment, and so enabling it to exert the necessary grip. By a special arrangement and adaptation of the spinning machinery the roughened fibres can be spun either alone or in admixture with cotton. The yarns so produced are said to be suitable for the manufacture of plushes, lace and other materials. Kapok textiles cannot possess such good wearing properties as those made of cotton, but owing to their non-conducting character they might find a special use as an interlining in warm clothing.

Kapok Seed

In the course of preparing kapok for the market large quantities of seed are obtained. The seed is rich in oil, and in many countries where the floss is prepared for local use the oil is expressed from the seeds and employed for cooking and other purposes. In the Dutch East Indies the seed now forms an important source of revenue; in 1924 about 14,000 tons, valued at £97,500, were exported from Java and Madura, of which all but 1,000 tons were consigned to the United Kingdom.

Samples of kapok seed from Travancore, the Federated Malay States, Gold Coast and Zanzibar have been examined at the Imperial Institute. The results are shown in the table on page 23, which includes for comparison the figures for Java kapok seed and oil and for cotton seed and oil.

It will be seen that in general characters the oil resembles cotton-seed oil. After refining it can be employed as an

	Kapok Seed and Oil						Cotton Seed and Oil.
—	Travancore.	Federated Malay States. I.	Federated Malay States. II.	Gold Coast.	Zanzibar.	Usual Range.	Usual Range.
Seed							
Moisture *per cent.*	11·4	13·8	12·9	13·2	12·7	—	—
Yield of oil *per cent.*	24·3	20·0	18·8	24·7	21·0	22–25	20–24
Yield of oil (moisture-free seeds) *per cent.*	27·4	23·2	21·6	28·4	24·0	—	—
Oil							
Specific gravity at 15°/15° C.	0·9217	—	—	0·9226	0·914	0·921–0·933	0·922–0·925
Acid value	30·9	54·1	61·0	6·1	26·0	variable	variable
Saponification value	192·2	—	—	193·5	194·2	189–195	192–195
Iodine value (Hübl, 17 hours) *per cent.*	90·4	—	—	89·6	101·5	85–94	105–115
Unsaponifiable matter *per cent.*	1·2	—	—	—	—	—	0·8–1·8
Refractive index at 40° C.	1·463	—	—	—	—	1·4605–1·4657	1·4646–1·4653
Solidifying point of fatty acids	29·8° C.	—	—	—	—	27–32° C.	33–37° C.

edible oil, and it is also suitable for soap-making and other purposes to which cotton-seed oil is applied. There is a steady market in the United Kingdom for kapok seed, and a small consignment received at the Imperial Institute from the Federated Malay States was sold in Liverpool in March 1925 at the rate ruling for Java kapok seed, viz. £11 15*s.* per ton, c.i.f. As regards the marketing of the seed the Institute is informed that it is the custom in this country to allow 25 per cent. of damaged seed in a consignment without any reduction being made in the price, notwithstanding the fact that the seed obtained from kapok plantations in Java contains, as a rule, only a little over 4 per cent. of defective seed.

The residual cake, left after the expression of the oil, forms a fairly good feeding-stuff for live-stock; it is somewhat inferior to cotton-seed cake, and is believed to be used principally as an ingredient in compound feeding-cakes. The composition of the meal obtained from Travancore seed at the Imperial Institute is shown in the following table, in comparison with commercial kapok-seed cake and undecorticated cotton-seed cake.

—	Kapok meal from Travancore seed. As prepared at the Imperial Institute.	Kapok meal from Travancore seed. Calculated to contain 7 per cent. of fat.	Commercial kapok-seed cake.[1]	Undecorticated cotton-seed cake English make.[1]
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	13·8	12·9	13·8	13·8
Crude proteins	32·7	30·6	26·2	24·6
Fat	0·5	7·0	7·5	6·5
Carbohydrates, etc. (by difference)	19·8	18·4	23·2	29·3
Crude fibre	26·8	25·1	23·2	21·2
Ash	6·4	6·0	6·1	4·6
Nutrient ratio	1 : 0·6	1 : 1·1	1 : 1·5	1 : 1·67
Food units	103	112	107	107

[1] Smetham, *Journ. Roy. Lancs. Agric. Soc.*, 1914.

The cake is rich in constituents of manurial value, the percentage (expressed on dry matter) in the case of cake prepared in Indo-China being as follows (*Bull. Econ. Indochine*, 1925, **28**, No. 174, p. 459):

Nitrogen		4·5
Phosphoric Acid	(P_2O_5)	1·6
Potash	(K_2O)	1·5

Indian kapok seed (*Bombax malabaricum*) yields an oil similar to that obtained from true kapok seed, but of slightly better quality (see this Bulletin, 1920, **18**, 335). The residual cake is rich in proteins and would form a more valuable feeding-stuff than kapok-seed cake.

Other By-products

The wood of the true kapok tree is light and soft and little used, even by the natives. It has been suggested that the wood might be suitable for paper-making, but experiments conducted some years ago by a firm of paper manufacturers in this country were not very satisfactory, and it was not considered that the production of pulp from the material would be a commercial success. More recent experiments in France showed that the wood yields 30 per cent. of bleached pulp (expressed on the dry material), which furnishes a paper of ordinary quality (*cf.* this Bulletin, 1924, **22**, 501).

The young leaves and the roots are used in native medicine, whilst the bark contains a reddish-coloured fibre sometimes used by the natives for tying purposes.

Production of Kapok in the Empire

Asia

True kapok grows in the hot moist tracts of Western and South India and in Burma, but it is nowhere systematically planted. The internal trade in the floss is stated to have developed considerably, but the quantity shipped is small, most of the so-called kapok exported from India consisting, as already mentioned, principally of the floss of *Bombax malabaricum*. So far as can be judged from material examined at the Imperial Institute, the true kapok produced in India is of good quality. A sample from Madras examined in 1906 was considered by brokers to be fully equal to good Java kapok (see this Bulletin, 1909, **7**, 13), and a sample from Travancore recently received at the Institute was also favourably reported on.

The exports of Indian kapok, chiefly from Bengal and Bombay, in 1923–4 amounted to 1,692 tons, of total value £136,000. Of this quantity 448 tons were shipped to the United Kingdom, 272 tons to the Netherlands, 210 tons to Germany, 196 tons to France, 140 tons to Italy, 110 tons to the United States and 75 tons to Australia.

Two grades of Indian kapok are recognised on the London market, viz. Calcutta and Bombay. Double-cleaned Calcutta kapok was recently quoted at 1*s.* to 1*s.* 0½*d.* per lb., or 3*d.* less than prime Java.

Eriodendron is a common tree in Ceylon and is widely distributed. It grows from sea-level to 2,500 ft. or more, but gives the best results at low and intermediate elevations. It is planted in village gardens and on some estates as a boundary tree. There is a small export of kapok from the island, the quantity in recent years amounting to about 300 tons, most of which has been consigned to the Netherlands. The quality is usually intermediate between Indian and Java kapok.

In parts of Malaya the kapok tree is grown in considerable numbers by the peasants, but hitherto little use has been made of the product except for domestic purposes. The Agricultural Department have recently made an exhaustive study of the possibility of establishing an export trade and have initiated a scheme for collecting the

pods from existing trees and selling the floss and seed. Further, they definitely assert that Malaya is suitable for the profitable production of kapok under plantation conditions (*Malayan Agric. Journ.*, 1923, **11**, 1).

It is estimated that at the present time there are about 100,000 trees in Malaya, of which 7,500 are in Selangor (mainly in Kuala Selangor); 3,800 are scattered in Pahang; 62,000 are in Perak (of which 40,000 are near Perak River and 20,000 in Krian); 7,000 are scattered in Malacca; and 6,100 are in Penang (4,000 of which are in Balik Pulau). Of the trees now in bearing nearly three-quarters are to be found in the four definite workable areas mentioned in brackets above. It is in these districts that endeavours will be made to teach the Malays to harvest the pods and prepare the floss for the market. Collecting centres will be established at which kapok brought in by the natives will be purchased for cash. In certain districts arrangements have already been made, under European management, for the purchase of kapok and its preparation for the market.

Kapok of fairly good quality has been produced in Mauritius, but, owing to the ravages of a beetle, the cultivation of the tree had to be given up (see p. 35). A sample of floss from trees grown at the Botanic Gardens, Pamplemousses, was examined at the Imperial Institute in 1906. It was slightly darker than ordinary Java kapok, more uneven in colour and somewhat inferior in lustre. Similar material would find a market in this country at prices a little below that of the Java product.

Africa

The kapok tree reaches a very large size in the West African forests, being only exceeded by a few mahoganies. It occurs in all the British Colonies of West Africa and is found in both the evergreen and mixed deciduous forests. No systematic attempt seems to have been made to collect the floss, except in Togoland. Here kapok received special attention under the German régime and seed was distributed in large quantities to the natives. The tree occurs throughout the whole of the Mangu-Jendi District in Northern Togoland, part of which is now included

within the British sphere, but it is considered that the establishment of any extensive export trade from this district would have to await the provision of railway transport. Before the war there was a small export from Togoland, 9 tons being shipped in 1913. This is stated to have been derived mainly from wild trees. A small bale of kapok from Togoland was received at the Imperial Institute from the Chief Commissioner, Northern Territories, Gold Coast, in 1916. It was similar in all respects to the kapok of commerce and was sold at a satisfactory price, considering the small quantity available (see this BULLETIN, 1917, **15**, 19). It would certainly be worth while to encourage the natives to collect and clean the material for export, both in this district and in other parts of British West Africa. It will be necessary, however, to insist on the systematic picking of the pods in order to maintain the quality of the floss, and not to allow the natives merely to gather the fallen pods, as they at present do for their own use. The results of examination of material received in recent years at the Institute from the Gold Coast and Gambia indicate that kapok of good quality could be produced in those countries if due care were taken in the preparation.

In East Africa the systematic cultivation of kapok has been undertaken in Tanganyika. Before the war the industry was increasing, the area under cultivation in 1910, 1911 and 1912 being 1,735, 3,458 and 6,580 acres respectively, and the exports in those years being 12, 28 and 52 tons. No information appears to be available as to the present area under kapok in the Territory, but it has been stated that the plantations suffered damage by elephants, both during and since the war. There are signs, however, that the industry is reviving, and during the four years ending 1924, quantities of 6, 30, 32 and 52 tons respectively were exported. The local Department of Agriculture do not seem to favour any extension of the cultivation, as the kapok trees are liable to harbour insect pests which may spread to the cotton-fields.

Kapok is stated to grow well in the coastal region of Kenya, and it is planted commonly as a boundary tree in Zanzibar. Floss produced in Government plantations

in the latter country is stated to have been exported to the United Kingdom.

The tree thrives well in the Sudan, and floss obtained from trees planted at Mongalla was examined at the Imperial Institute in 1917. It proved to be of excellent quality, and similar material, if produced in commercial quantity, should realise the market price of good Java kapok (see this BULLETIN, 1917, **15**, 19).

West Indies

The kapok tree is found in most of the West Indian islands; one, at Nassau, Bahamas, has reached a very large size and is familiar to all visitors to that island. There seems little hope, however, of the floss from existing trees in the West Indies being collected for export, owing to their very scattered distribution. Moreover, it is unlikely that the tree will be planted specially for the production of floss, on account of its harbouring a cotton stainer; indeed, for this reason it has been made compulsory in St. Vincent that all kapok trees should be destroyed.

An attempt was made some years ago to introduce the cultivation of the tree into British Guiana, and a number of plants were raised for distribution; but no development appears to have been recorded.

Australasia

The tropical parts of Australia seem suitable for the cultivation of kapok, and a few trees already exist round some of the towns in Northern Queensland. The Agricultural Department in Queensland have drawn attention to the possibility of producing the floss for the Australian market, at present supplied by Java, and point out that the tree can be grown practically along the whole of the Queensland coastal belt from Brisbane northwards. They suggest that the most profitable method in that area would probably be to plant the trees as wind-breaks or shade trees, rather than in the form of pure plantations.

In New Guinea, under the German régime, kapok trees were regularly planted for several years and the crop was collected and exported. The produce was of good quality and realised satisfactory prices, but the cultivation

was stated to be unprofitable, chiefly on account of the high cost of transport, and was, therefore, abandoned.

The kapok tree is cultivated by natives in all parts of North Borneo, but the industry has made little progress, as the floss has mostly been shipped in the uncleaned state. The cleaned floss, however, is of excellent quality, and has been sold in the London market at the price of the best Java kapok. In 1919 a concession was granted to a London company giving them the sole right to export kapok from the territory, and in return they agreed to purchase at a fixed minimum price all kapok offered to them. The company also undertook to install cleaning machinery and to export a minimum quantity of cleaned floss per annum. In the event of the supply of kapok being insufficient the company will themselves undertake planting operations. During the first year (up to July 1920), the company had purchased from producers 38 tons of kapok, most of which was shipped to London, and small quantities have continued to be exported each year since.

Attention is also being devoted to kapok in Samoa. The tree grows practically wild throughout the islands, and is at present chiefly used as a wind-break in cocoa plantations.

CULTIVATION

Climate

A suitable climate is the first essential to the successful cultivation of the kapok tree. Although found in a wild or semi-wild state from the sea-level up to an altitude of 3,000 or even 4,000 ft. and more, the tree gives the best yield and quality of fibre when grown at elevations less than 1,500 ft. above the sea. It will withstand slight frost, but low temperatures hinder the growth of the tree and the development of the fibre, and from a commercial point of view cultivation should be attempted only in the tropics or in certain parts of semi-tropical countries. As regards rainfall, the tree flourishes under a wide range of conditions. It reaches its greatest size in the tropical rain forests of West Africa, but at the same time, owing to its deciduous habit, it can resist long periods of drought.

The ideal conditions are abundant rain during the growing season and a dry period from the time the flowers are setting until the pods are harvested. As in the case of cotton, a long spell of wet or even damp weather during the later stages of pod formation will greatly reduce the quality of the fibre.

The quick-growing branches are easily broken or damaged by high winds, and exposed situations should therefore be avoided in fixing the site of plantations.

Soil

A well-drained soil is necessary for the proper growth of kapok. It flourishes well on a deep, porous, sandy loam, such as is frequently found on alluvial flats along streams, but the finest kinds of Java kapok are produced on well-weathered volcanic soil. It is not always advisable to plant the better land exclusively with kapok, since this can often be more profitably used for other crops. Nevertheless, a soil of fairly high fertility is required since the returns from kapok are relatively low, and a high yield is therefore essential.

Land infested with white ants should not be used for kapok since the tree is very susceptible to the attack of these insects.

Propagation

The tree is easily propagated from either seed or cuttings. The merits of the two methods have been a matter of dispute. Plants raised from cuttings come into bearing somewhat earlier, but, on the whole, the general opinion is in favour of propagation by seed. Advantages of the latter method are that a deep-growing tap-root develops which renders the plant less liable to be uprooted by high winds, and the plants remain longer in bearing. Where a form notable for its high yield or other specially favourable character is to be reproduced, cuttings should be employed.

Seed for sowing should, whenever possible, be specially obtained from the largest pods of old high-yielding trees, instead of using purchased seed of unknown parentage produced in the course of cleaning the floss. About 6 lb.

of seed should be sufficient for planting up 100 acres. The seed is sown in nurseries, sometimes in rows 10 to 12 in. apart in raised beds, or, as recommended in the Philippines, in "hills" about 6 in. apart. The nursery must be carefully prepared, the soil manured beforehand, if poor, and kept well weeded. In dry weather watering may be necessary. As soon as the seed has germinated, which takes only a few days, the seedlings are shaded until they are about 5 or 6 in. high, when they must be exposed to the sun. If the plants do not obtain plenty of sunshine they grow thin and lanky. At this stage the seedlings should be thinned out to 6 or 9 in. apart; when sown in hills only one seedling should be allowed to each hill. The young plants grow very quickly, and when from 6 to 12 months old they should be planted in their permanent quarters.

Owing to the readiness with which kapok cuttings take root, this method of propagation has hitherto been that most commonly used by the natives of Ceylon and the Philippines. The cutting, which should never be of the current year's growth, varies in size from about ¾ to 2 in. or more in diameter and from 18 in. to 6 ft. or more in length. Experiments conducted in the Philippines with cuttings ranging in length from 1 to 10 ft. and ½ to 5 in. in diameter at the base, showed that the larger cuttings gave the best results, 100 per cent. of those 6 ft. or more in length and 3½ in. or more in diameter striking root, as against from 15 to 70 per cent. in the case of the smaller cuttings. The cuttings should be inserted as soon as they are cut, about 12 to 18 in. deep according to their size, and this work should be done, if possible, at the beginning of the rainy season. The cuttings must be inserted in the place they are to occupy permanently.

Planting Out and After-cultivation

In Java, and indeed in most countries where the natives cultivate kapok, the trees are most commonly planted irregularly, as boundary trees and fences, along the sides of roads, or with other trees in the gardens. It is from such indiscriminately planted trees that most of the kapok produced is still obtained. In Java the tree is sometimes

planted between other crops, such as coffee, cocoa, pepper and vanilla, whilst in the Philippines it has been suggested that fibre crops like maguey, sisal and mauritius hemp, might be interplanted with kapok. The most suitable crop to be grown in this way will vary with local conditions, and from observations made in Malaya it is thought that roselle fibre, sunn hemp, tuba, limes and tobacco should prove successful. In quite recent years the practice has been commenced in Java and the Philippines of growing kapok as the sole plantation crop; but this method will probably only give profitable results where the conditions are specially favourable to the production of high yields.

When grown as the only crop in plantations the seedlings or cuttings should be placed about 18 ft. apart, but in mixed plantations the distance will vary with the nature of the accompanying crops. The seedlings, when removed from the nursery, should be topped and all leaves removed. In lifting the plants, the roots must be damaged as little as possible, and planting out should be done immediately. If possible, transplanting should be performed during showery weather.

Little cultivation of the soil is required in kapok plantations. For a few months after planting the soil should be kept loose round the plants, and if kapok is the sole crop it is only necessary to keep the ground clean for a short distance from the tree to facilitate the collection of the pods. The remainder of the plantation is preferably planted with a leguminous cover crop, so that the cost of weeding is reduced to a minimum.

Harvesting and Yield

Where, as in Java, the pods ripen during a dry season, they are often collected each day as they fall to the ground, but if rains are liable to occur during the harvesting period, the pods must be picked from the tree as they mature; otherwise the floss may suffer considerable damage. As the pods ripen their colour changes from a light green to a light brown and the surface, at first smooth, becomes somewhat wrinkled. It is at this stage, and before the pods open at the end, that they should be picked. It is no economy to harvest the whole crop at once, since this

will result in a mixture of unripe, ripe and over-ripe pods, which will give a product of low value. The ease with which the branches break precludes the gathering of the pods from tall trees by climbing, and they are best gathered by means of knives or small hooks attached to long poles. The harvesting season usually extends over a period of about 3 months. The pods must be spread out on a dry floor in the sun to ripen thoroughly and the floss removed as soon as possible. If it is necessary to store the pods for a time, they must be thoroughly dried, so as to avoid fermentation and discolouration of the floss.

Kapok trees usually begin to bear after 3 or 4 years, but the yield at first is small. Seven-year old trees will yield 350 to 400 pods, and 10-year old trees 600 pods or more. The yield of cleaned floss from the pods varies somewhat, but on the average it may be taken that 100 pods furnish 1 lb. of cleaned floss. On this basis an acre planted with 132 trees (18 × 18 ft.) would yield about 80c lb. of floss.

Preparation of the Fibre

Although machinery is now largely employed for cleaning kapok in Java, the initial process of opening the pods and removing the floss and seeds from the husk and core is always done by hand, chiefly by women and children. The subsequent separation of the floss from the seed is the most important process in its preparation. A common native method is to place a quantity of floss and seeds on a perforated platform and beat it with bamboo sticks, wielded in a horizontal direction, so that the seeds are loosened and fall through the holes in the platform. This is continued until the floss is beaten up into a snow-like mass. The top layer is then removed and given a further beating on another platform, when the floss is ready for baling. In an improved method, which has come into use in Java, the floss as it comes from the pods is placed in a bamboo basket or hollow cylinder with a perforated base, and the mass stirred up by a paddle-like arrangement revolved within it by means of a handle. These hand methods are only of use where kapok is produced on a comparatively small scale. On a large scale machine-cleaning is essential. Most of the machines

hitherto employed consist of a horizontal chamber with a perforated bottom, in which the floss is beaten up by a series of blades revolving close to fixed blades on the sides of the chamber. The blades are so arranged that the floss moves along to the end of the chamber, where it is either blown out by fans or falls into receptacles. The Bley machine, invented by a Java planter, is claimed to be able to clean 217 kilos. of floss per hour. This could only be used profitably on a very large scale. A smaller machine, of British manufacture, capable of cleaning 120 to 130 kilos. of floss per day of 10 hours, has been used in the Philippines.

Kapok should always be graded carefully before baling for export. As a rule, four grades of cleaned Java kapok are recognised: (1) Superior or extra, containing less than 0·5 per cent. of seed; (2) prime, containing not more than 2 per cent. of seed; (3) fair average, with not more than 3½ per cent. of seed; and (4) damaged.

Owing to the bulky nature of the material, the floss is pressed into bales for export. The pressure applied will depend on the size of the bale, but too much must be avoided, particularly with the finest quality, otherwise the elasticity of the fibre will be destroyed. Machine-cleaned, very dry fibre requires more pressure than hand-cleaned, but on the average the pressure should not exceed 140 lb. per sq. in. Thus a bale 2 ft. wide by 2 ft. long will require a pressure of 80,640 lb. The bales are generally packed in gunny cloth or matting and are bound with galvanised iron hoops, cane, or fibre. The weight of the Java bales ranges from 80 to 120 lb. and the size from 8 to 16 cubic ft.

Pests and Diseases

So far few insect pests and fungoid diseases have been recorded as causing any great damage to the kapok tree or floss. This may be due to the custom, most frequently followed at present, of growing the tree in isolated positions. If large plantations are made it will be necessary to keep careful observation to prevent the spread of harmful insects and diseases, just as is the case with other plantation crops.

In Malaya and certain other countries white ants are the most serious pests, especially to young plants, and the usual precautions against these insects must be taken. An insect (*Dysdercus cingulatus*), allied to the cotton stainer, sometimes attacks the pods, but the damage is said to be slight. A related species has also been reported on kapok in San Thomé. It is sometimes considered inadvisable to grow kapok in the vicinity of cotton, owing to the danger of stainers spreading to the latter crop and, as already stated, in St. Vincent all kapok trees have to be destroyed. There is little risk, however, if the trees are properly tended and care is taken not to allow old pods to lie on the ground. In the Belgian Congo, kapok trees in the neighbourhood of cocoa plantations are cut down, owing to the fact that they serve as host-plants for a serious cocoa pest, *Sahlbergella singularis*. Caterpillars of several kinds of moths do a certain amount of damage, and one of them (*Mudaria variabilis*) in certain years has been known to destroy a large proportion of the crop in Java. In 1914, for example, it is recorded that 30 per cent. of the pods were attacked. The caterpillar feeds on the undeveloped fibre and seeds of the green pods, and even if any fibre should mature it is usually badly stained, whilst birds in their search for the caterpillars often complete the destruction of the pods. Other caterpillars bore into the stem and twigs, and some feed on the leaves. Boring beetles of the genus *Batocera* also attack the tree, and one of them (*B. rubra*) is so partial to it in Mauritius that kapok cultivation has had to be given up in that island.

Bats, monkeys and squirrels sometimes do considerable damage by eating the green pods or growing shoots.

Among the worst enemies of kapok in Java and Malaya are parasitic flowering plants of the genus *Loranthus*, which send out suckers into the bast and wood of the tree and absorb the nutriment required by the growing shoot. In bad cases the whole tree becomes weakened by the loss of the necessary nourishment and great damage may thus be caused. The trouble is not difficult to control if the plantation is properly inspected at regular intervals and all parasites removed as soon as they make their appearance.

Among the few fungoid pests of kapok, pink disease (*Corticium salmonicolor*) has been known to attack the plant, and leaf spot (*Ramularia eriodendri*) and an unidentified disease causing bleeding at the base of the trunk have occasionally been reported.

Bibliography

The following list includes the most important publications dealing with kapok issued in recent years. Most of them may be consulted in the library of the Imperial Institute, where further information is available regarding the various points dealt with in this article. Those marked with an asterisk have been largely consulted in compiling the notes on cultivation.

Bley, G. F. J.: " De Kapokcultuur op Java." (Soerabaia, 1911.)

Crevost, C. and Lemarié, C.: " Plantes et Produits Filamenteux et Textiles de l'Indochine. Ouatiers." *Bull. Écon. Indochine* (1919, **22**, No. 137, pp. 553–591).

*Grist, D. H.: " Kapok." *Malayan Agric. Journ.* (1923, **11**, 3–27).

Houard, A.: " L'Exploitation du Kapok en Afrique occidentale française," in Henry's " Matières Premières Africaines," Tome I, pp. 154–218. (Paris, 1918.)

*Mathieu, E.: " Kapok." A Lecture given at Kuala Kangsar, Aug. 16, 1922. (Singapore, 1922.)

*Saleeby, M. M.: " The Kapok Industry." *Bull.* No. 26 (revised ed.), *Philippine Bur. Agric.* (Manila, 1925.)

Schaefer, H.: " Die Produktion von Kapok und dessen Stellung in der Weltwirtschaft." *Beiheft zum Tropenpflanzer* (1925, **22**, No. 1, pp. 1–54).

Zimmermann, A.: " Der Kapokbaum (*Ceiba pentandra*)." *Der Pflanzer* (1914, **10**, 123–133).

Warburg, O.: " Baumwolle-Ersatzstoffe." *Verhandlungen der Baumwolle-Kommission der Kol. Wirt. Kom.* (1911, No. 2, pp. 62–80).

NOTES

New Zealand Kauri-gum Industry.—The position of the kauri-gum industry, one of the major industries of New Zealand, has been a matter of anxiety to the authorities for some years. The exports, which in 1913 amounted to 8,780 tons, valued at £549,106, fell to 2,338 tons (£152,299) in the fiscal year 1918–19. An improvement over this figure was shown in post-war years and in 1923–4 6,923 tons, valued at £640,712, were exported, but last

year (1924–5) there was a decline to 5,432 tons (£446,019) (*Rep. Kauri-gum Industry, New Zealand, for the Year ending 31st March*, 1925). On the recommendation of a Commission appointed by the Dominion Government in 1914 steps were taken to foster the industry and to assist the gum producers by advancing monetary grants on their stocks. In 1921 a further Commission was appointed to enquire into and report on the industry. A summary of their report will be found in this BULLETIN (1922, **20**, 331). Further steps have now been taken by the Government, and a Kauri-gum Control Board, organised on lines similar to those of the Dairy Products Control Board and other Boards dealing with New Zealand produce, has been set up by Act of Parliament of October 1, 1925. The Act came into force on April 1, 1926.

The Board is to consist of five members, viz. two Government Representatives, one of whom shall have expert knowledge of the handling, grading and marketing of kauri-gum ; one representative of the exporters, to be appointed by the Government, but who is not engaged directly or indirectly in the kauri-gum trade ; and two members to be elected by producers. The Board is empowered to prohibit the export of kauri-gum except under licence, and to assume control of all kauri-gum produced in New Zealand. The extent to which the control is effected is left to the discretion of the Board. In cases where it has assumed absolute control the gum may only be sold or disposed of by direction of the Board. The Board has full powers to make arrangements for the grading, mixing, pooling and storing of kauri-gum ; for its sale and disposal on such terms as it thinks advisable ; for the establishment of depots for the purpose of receiving, recleaning, regrading and otherwise preparing kauri-gum for sale either in or beyond New Zealand ; for the acquisition of the right to use any patented process for the recovery, treatment or grading of kauri-gum ; for the purchase of gum by payment in full or by means of advances ; and for undertaking experiments with a view to improving the methods of recovery and treatment of kauri-gum or promoting its trade and sale.

It will be seen that the Board has very full powers to control the industry, and it is hoped that it will prove as valuable to the kauri-gum industry as the Dairy and other control Boards have proved in their respective spheres. It is pointed out, however, in a detailed review of the Act, published as *Special Circular No.* 1-26, of the Chemical Division of the United States Bureau of Foreign and Domestic Commerce, that many of the factors leading to

the present position of the industry, such as the decline in the demand from the United States, are beyond the control of the New Zealand Board. The chief customers for kauri-gum are the United States and the United Kingdom, but whereas the demand from the latter country shows only a very slight decrease as reflected in the exports during the last two years, the exports to the United States fell from 4,197 tons in 1923–4 to 2,624 tons in 1924–5. It is the better grades of gum which are sent to the United States, and the decline in American purchases, according to the *Special Circular*, is attributed to a report that American automobile manufacturers are experimenting with a synthetic product which will largely eliminate kauri-gum as an ingredient of the varnishes and lacquers for motor-car bodies. Further, the *Circular* points out that although kauri-gum has a high standing, it enters into open competition with other resins and any valorisation scheme will, therefore, be difficult to work. It is considered that the most useful functions of the Board will be the elimination of competitive buying in New Zealand, the direction of research work on new uses for the resin and the carrying on of publicity campaigns to increase the appreciation of the resin for such uses.

Sugar Industry of Queensland.—The latest Annual Report of the Director of the Bureau of Sugar Experiment Stations, Queensland, records a very satisfactory progress in the sugar industry of that State. The past five years have seen a marked increase in the acreage under cane and in the number of cane-growers. In 1920 the total area under cane was 162,619 acres, and in 1924 this area had increased to 253,519 acres. During the same period the number of cane-growers increased from about 4,000 to over 6,000. The 1925 season was particularly favourable for the growth of the crop, and it is expected that the production of sugar will exceed all previous records. The crop of cane for the season is estimated at about 3¾ million tons, giving a yield of 484,000 tons of raw sugar, as compared with 3,176,142 tons of cane and 409,136 tons of sugar in the 1924 season. In addition to this amount for Queensland, it was anticipated that New South Wales would produce some 32,000 tons, while Victoria's beet sugar factory had yielded 3,017 tons in 1925. This should give an approximate production for Australia of 519,017 tons of sugar, which considerably exceeds the home consumption.

The average annual yield of cane per acre for the six years ending 1924 was less than during the previous decade. This is attributed to the number of dry seasons experienced.

The yield of sugar per acre, however, has increased, since the number of tons of cane required to make a ton of sugar is now much lower. This favourable result is due largely to the improved efficiency of the mills and to the work of the Cane Prices Board and the Sugar Experiment Stations. There are three such stations, situated in the northern, central and southern cane-growing areas, where manurial, selection and other experiments are conducted to suit the conditions of the respective districts. Work on insect pests forms an important part of the work of the Bureau, and special attention is devoted by the Division of Entomology to the sugar-cane grub, which is the worst pest of the cane in Queensland. Three Field Assistants inspect the cane areas and give advice to growers, whilst another officer travels through the various districts giving advice on the control of diseases and pests and assisting farmers to recognise them. From the reports of the Field Assistants it is evident that the proportion of farmers who use lime, green manures and fertilisers is much too small. At present there seems to be a tendency for farmers to obtain their crop in comparatively small yield on large areas of land. It is pointed out that this state of affairs must be reversed, but this can only be done by the intelligent use of better methods of cultivation and manuring. A hopeful sign in this connection is the greater interest in experimental work that has been taken in recent years by farmers generally.

With few exceptions, all the sugar-growing areas of Queensland are along the coast. The industry is extending rapidly in the northern districts, where the high rainfall and humid atmosphere are better suited to the growth of the cane. In the districts north of Townsville the output of sugar has increased from 57,135 tons in 1910 to an estimated production of 215,550 tons in 1925, whilst in the same period the area under cane has increased more than 100 per cent. As indicating the importance of the sugar industry to the State, it may be mentioned that a far larger increase in population during the past few years has taken place in these districts north of Townsville than in any other part of Queensland.

The Imperial College of Tropical Agriculture.—A copy of the Prospectus of this college for the year 1926–7, containing the Principal's Report for the academic year 1924–5, has been recently received at the Imperial Institute. The useful work which the college is performing in training students in the science and practice of tropical agriculture cannot be too widely known. The college

buildings and laboratories are situated at St. Augustine, seven miles east of Port of Spain, Trinidad. An area of 15 acres is under experimental cultivation on the college estate, and the students are within easy access of estates and plantations where almost every kind of tropical crop is grown. They also have facilities for visiting factories for the study of the chemical technology of sugar, cocoa, coffee, copra, citrus products and rubber, while the college itself now possesses an instructional sugar factory where a thorough practical course is given in the manufacture of sugar.

It is hoped before long to acquire for the college an agricultural estate which will offer full facilities for the study of tropical agriculture in all its branches. For this purpose, and partly also to provide a hostel for students, the Governing Body, of whom Sir Arthur Shipley, C.B.E., F.R.S., is chairman, are appealing for a sum of £45,000.

An important feature of the college is the provision for research and investigation afforded by its laboratories and fields. The work done during the last academic year has included the study of banana cultivation and trade, particularly with a view to the production of a variety immune to Panama disease; investigations on seedling sugar canes, and the froghopper pest; on cocoa, cotton, tobacco, plant diseases, soils, and the biochemistry of lime juice.

The college was opened in 1922 and the academic year 1924–5 therefore completes the first 3-year diploma course. Late students of the college now hold important positions in Uganda, Gold Coast, Sudan, Southern Rhodesia, Nyasaland, Ceylon, Natal, British Guiana and the West Indies.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important, recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

FOODSTUFFS

Bananas.—In 1924 an investigation of "Bunchy Top" disease of bananas was started in Queensland, on the recommendation of a commission which represented the Commonwealth Government and the New South Wales

and Queensland Governments. An Investigation Committee was appointed and its first report has now been published (*Queensland Agric. Journ.*, 1925, **24**, 424). It is shown that "Bunchy Top" disease is caused by a virus, transmitted by the common dark banana aphid, *Pentalonia nigronervosa.* Further work is to be carried out on the life-history and habits of the aphides, and the liability of other plants to the disease. Control measures are being studied, and in the meantime growers in lightly affected areas are recommended to spray affected stools and the surrounding soil with a preparation known as "Black Leaf 40" in order to kill any aphides present, and to dig out the stool completely. For heavily infested areas it is tentatively suggested that affected plants should be removed, and that spraying should be employed to control the infection from abandoned, affected plantations in close proximity.

Sugar.—The possibilities of cultivating the sugar beet in Bihar, India, are discussed in *Agric. Journ., India* (1925, **20**, 380), and the prospects of success are stated to be favourable. The existing cane-sugar factories in Bihar are at a disadvantage, as the cane-sugar season is very short. Canes cannot be kept in the field after March owing to the approach of very dry weather. It has been shown that sugar beet of good quality can be made available till the end of May, and the manufacture of sugar from beet may thus follow the cane season and prolong the working days of the mills by two months. Further, the sugar beet is a six months' crop, whereas cane occupies the ground for about a year. Other points in favour of beet cultivation are: (1) the manurial requirements of the beet are smaller than those of cane; (2) the exhausted pulp and leaves may be fed to cattle; and (3) its water requirement is much less. A drawback, however, is that it does not lend itself to the establishment of a cottage industry like that of the manufacture of gur from cane.

Rice.—*The Record* (Bangkok, Siam; English Edit. No. 18, Oct. 1925, p. 116) contains a report on the padi crop of Siam for the year B.E. 2467 (1924–5). Of the total area planted, amounting to approximately seven million acres, four million acres were within the seven circles which provide the bulk of the exported rice. In these circles the crop for the year amounted to 2,845,000 tons of padi, and was about 654,000 tons more than in 1923–4 and about 470,000 tons more than in 1922–3. The average yield of the fields harvested works out at

0·76 ton per acre, an increase of 0·09 ton per acre over the yield in 1923–4. The cultivation of padi in the seven exporting circles is definitely on the increase.

Coffee.—*Bull. No.* 1 of 1925, *Dept. Agric., Kenya*, entitled "The Coffee Industry of Kenya Colony," by A. D. Le Poer Trench, gives a short detailed account of the industry and of the costs of developing a coffee estate.

Oils and Oil Seeds

Coconuts.—According to the *Annual Report of the Department of Agriculture, Seychelles* (1924, p. 2), the coconut industry in this Colony is improving. There was every indication that the crop in 1925 would exceed that of the previous year, which was the highest ever recorded and was estimated at 31 million nuts, an increase of 2 million nuts over that of 1923. It is estimated that 85 per cent. of the crop is converted into copra, and the exports of copra from the Seychelles in 1924 are given as 3,185 tons. The increase in the size of the crop is attributed, not so much to the good rainfall, as to the fact that estates have been manured, those in the outlying islands with guano and others with distillery waste and seaweed.

The pests and diseases of the coconut palm in the islands of the Southern Pacific are dealt with in *Bulletin No.* 16, *Dept. Agric., Fiji*, 1925. The pests are grouped according to the part of the palm attacked, short notes being appended in cases where the pest is well known and fuller accounts in connection with the newer forms. A description of diseases of fungoid origin and coloured illustrations of the more important insects are included.

Ground-nuts.—Strenuous efforts are being made in Gambia to improve the quality of the ground-nuts (*Ann. Rep. Dept. Agric., Gambia*, 1924, p. 24), and considerable attention is being paid to seed selection. Using raised platforms on which to stack the nuts is another means advocated, as this will prevent the development of moulds which cause the blackening of the shells and spoil the appearance of the nuts. Owing to the common practice of mixing sand and other foreign materials to increase weight, an Ordinance has been passed making it compulsory to screen all nuts purchased or stored for export. The screening removes sand and dirt and also the majority of shrivelled and immature nuts. Reference to the use of rotary screens in Gambia, and an illustration of one at work, were included in the article on the cultivation and

utilisation of the ground-nut published in this BULLETIN (1925, **23**, 291). In many cases, concrete floors are used on which to store the screened nuts, and in others grass or bamboo mats are used. As a result of these measures, the crop in 1924 showed a marked improvement over that of 1923, while the difference in price between Gambia and Senegal nuts has been decreased from 10*s.* to 5*s.* a ton. The percentage of foreign matter has been reduced to a negligible figure through the compulsory screening, and the average acidity of the oil has fallen to 1·2 per cent. The improvement in the quality shown by the 1924 crop was due partly to the fact that the plants were raised from seed carefully selected from the previous year's crop, whilst the climatic conditions were particularly favourable. Trials made at the Agricultural Station with Senegal seed from Cayor showed that this seed was not so suitable as the Gambia seed, the yield per acre of the former being 1,120 lb. in comparison with 2,055 lb. for the latter. Nigerian and Philippine seed have both given good results when grown under Gambia conditions. In 1924, 60,622 tons of ground-nuts, valued at £861,925, were exported from Gambia.

Oil Palm.—Particulars of the experiments on oil palms conducted in Ceylon are given in *Trop. Agric., Ceylon* (1925, **65**, 210). In 1915, 2¼ acres at the Anuradhapura Experiment Station were planted with seed obtained from the Gold Coast. Further plantings were made during the following year. The palms have been grown without irrigation, but the plots have received occasional ploughings and harrowings. The yields of fruit, which may be considered as an indication of the crops likely to be gathered from oil palms grown on non-irrigated land in the dry zone of this Colony, compare unfavourably with the yields reported from Malaya and show that dry conditions extending over a long period are not suitable for prolific fruit-production.

The results, generally, show that unless yields larger than those which have been obtained at the Experiment Station are obtainable there is little prospect for the oil palm as a plantation product in the dry zone of Ceylon. It is recommended that further trials with the oil palm should be made at the stations on the Batticaloa-Trincomalee Railway which is shortly to be opened.

According to the *Annual Report, Department of Agriculture, S.S. and F.M.S.*, 1924, p. 5, between 5,000 and 6,000 acres of oil palms had been planted in Malaya by

the end of 1924, and it is stated that the acreage is likely to increase very materially. A modern plant has been installed on one estate in Selangor. The exports from Malaya during the year under review amounted to 295 tons of oil and 40 tons of kernels. Malayan palm oil is stated as having already obtained a high reputation as an oil of good standard grade. Preliminary investigations have indicated that insects have little or no influence on the pollination of the oil palm in Malaya.

The *Second Special Bulletin of the Agricultural Department, Nigeria* (1925), is devoted to a consideration of mechanical processes for the extraction of palm oil. The process in which the whole fruit is digested and centrifuged is stated to give much higher yields of oil than the process in which the cooked fruits are depericarped and the pericarp alone centrifuged. The lower yield by the latter process is due to the fact that the oil cells are not so completely ruptured as they are in the digestion process. After reviewing the power-operated plants, the purification of the oil is considered. Removal of impurities and water is best effected by centrifuging the oil in a De Laval separator, especially if the crude oil is given a preliminary washing with hot water, whereby the grosser impurities are removed. Information is given relating to the importance of scientific control of the process, the methods to adopt and the routine chemical examination of the fruits and oil. As regards hand-operated machines for the treatment of palm fruits, it is considered that the field for such machines in Nigeria is very limited owing to the native prejudice to machinery and to the advantages not being sufficient to warrant their use. The prospects for small power-driven plants are not much brighter, as their cost is prohibitive except for the most wealthy producers. Native methods might, it is considered, be advantageously improved by using a cooker, such as the "Rapid," and a handpress, like the "Culley-Ducolson," whereby the yield and quality of the oil would be enhanced.

The methods used for the preparation of palm oil on the East Coast of Sumatra are outlined in *Comm. Gen. Exper. Sta., A.V.R.O.S., Gen. Ser., No.* 21, 1925. The bunches of fruits are sterilised under a pressure of less than three atmospheres to prevent an increase in the acidity of the oil, to loosen the fruits from the heads and the kernels from the shells, and to facilitate the liberation of the palm oil. The sterilised bunches are then threshed in a machine, the central shaft of which is fitted with arms sufficiently close to one another to allow the fruits only to pass between

them., The fruits thus separated are heated in a kettle provided with stirrers, whereby the oil is made more fluid and the pulp loosened. The heated fruits pass into hydraulic presses, in which the palm oil is expressed. The residue of fruits left in the presses is sieved in rotating octagonal screens to remove the pericarp waste. The nuts thus obtained are transferred to a perforated horizontal cylinder through which warm air or exhaust gases are passed. As the cylinder revolves, the nuts rub against one another and the fibrous material, still adhering after the previous operation of sieving, is removed. The pericarp-free nuts are then cracked in centrifugal or roller cracking machines. With the latter type of machines the nuts should be stored for a time before being cracked, in order to get the best results. The broken shells are separated from the kernels by means of a suspension of clay in water, having a specific gravity of 1·1, the kernels being afterwards dried until the moisture is reduced to 5–6 per cent. On some estates the pericarp separated by sieving is rejected ; on others it is given a second pressing, while on one estate the remaining oil is extracted by means of solvents. The expressed oil, after sedimentation and filtration, is ready for use.

ESSENTIAL OILS

Otto of Rose.—A special issue of *Perfumery and Essential Oil Rec.* (1925, **16**, 283–328) is entirely devoted to the cultivation of roses and the preparation of otto of rose. It contains a number of instructive articles, including one by T. Blishakoff on the Bulgarian industry. In Bulgaria roses thrive best and furnish the highest yield of oil (or otto) when grown on slopes 300 to 500 metres high, protected from northerly winds, where the soil is light and well drained and the climate mild and equable. The chief varieties grown are the red rose, *Rosa damascena*, Mill., and the white rose, *R. alba*, Linn. The cultivation of the latter is not recommended, for although it flourishes on poorer soil and furnishes about 40 per cent. more blooms than the former, it produces only about one-third of the amount of oil, which is not so fragrant and contains more stearoptene than the more valuable oil from *R. damascena*. The rose trees produce the greatest number of blooms in the fourth and fifth years, but give a profitable yield up to the age of 20 or 30 years. Picking is carried on for four or five hours in the early morning, and is paid for in the towns at the rate of 1 leva per kilo. of flowers, consisting of about 500 to 700 roses.

For various causes, rose cultivation in Bulgaria has rapidly declined since 1917 from 89,641 dekares (about 22,000 acres) to 49,680 dekares (about 12,000 acres) in 1924, when only 172,528 muskals (about 862 kilos.) of oil were produced. Blisnakoff's article also gives a detailed account of the method practised by the peasants of producing rose oil in the primitive distilleries or "gulapanas."

Another article describes the methods employed in some of the modern distilleries of Bulgaria, of which 77 are said to exist.

Vetiver Oil.—The results of three years' experience in the cultivation of vetiver grass, and the production of the volatile oil from the roots, carried out by Messrs. Niilbem, Ltd., in Java, are given in *Perf. and Ess. Oil. Rec.* (1925, **16**, 371).

The company's plantations are situated at an elevation of 5,000 to 5,500 ft.; the temperature in this zone ranges from 40 to 75° F. throughout the year; the rainfall is sufficient and the soil fertile with free drainage. Light, sandy, loose soils are the best for the crop, as they ensure good root development; on marshy ground, the natural habitat of the plant, the roots are difficult to collect, and they are liable to be deficient in oil. The grass is propagated by planting divisions of the root 2 ft. by 3 ft. apart during the rainy season. The roots are collected in the dry season. The grass requires nine months to attain full growth at the elevation of the plantations, so that one crop only is obtainable each year. The annual yield is about 1,000 kilograms of sun-dried roots per hectare (900 lb. per acre).

The oil is obtained by direct distillation with steam at a pressure of 10 lb. per sq. in., gradually rising to 20 lb. per sq. inch. The dried roots are first cut into pieces as fine as possible by means of a chaff-cutting machine, and are then soaked for about seven hours in fresh water at 60–70° F. Freshly gathered roots are not submitted to any preliminary soaking. About 15 hours are required for the complete distillation of a batch of roots, weighing about 70 kilograms, in a still of 1,000 litres capacity.

The collection of the oil from the distillate is a difficult task, owing to the viscous character of the oil, and specially designed separators have to be employed. No chemicals, however, are used as this tends to spoil the quality of the oil. The oil so obtained is filtered, and stored in a dark room or in dark bottles. The yield of oil varies from 2 to 3 per cent., expressed on the dried roots. Yields of about 4 per cent. may be obtained by increasing the time of dis-

tillation and raising the steam pressure, but the company find this to be uneconomical.

The oil obtained in the above manner is of good quality, and a sample was valued by an expert at 8*s.* to 10*s.* per lb. higher than the London price of " Bourbon " oil. The best Java vetiver oil has a clear tea colour, is transparent, and has a sweet aroma.

Fibres

Cotton

Nyasaland.—It is stated in the *Rep. Dept. Agric., Nyasaland Protectorate, for the Year* 1924 that the area devoted to cotton by European planters in that year was 26,120 acres, as compared with 20,948 acres in 1923 and 24,006 acres in 1914. The production of lint amounted to 15,422 cwts., the average yield per acre being better than in the previous year although still far too low. Considerable fluctuations in the yield are bound to occur so long as the crop is dependent on the rainfall for its moisture, and no approach to stability in the production can be expected until large areas below the 2,000 ft. contour line have been brought under irrigation.

The quantity of cotton produced in 1924 by the natives in Nyasaland was the highest on record, and amounted to 1,369 tons of seed-cotton, as compared with 749 tons in 1923 and 387 tons in 1922. In each of the cotton-growing districts an increase in output occurred, as is shown below:

District.	1923. *Tons.*	1924. *Tons.*	District.	1923. *Tons.*	1924. *Tons.*
Lower Shire	477	732	Liwonde	—	11
Chikwawa	75	128	South Nyasa	14	101
Central Shire	53	99	Dedza	—	12
Mlanje	61	83	Dowa	—	6
Ncheu	37	100	Karonga	32	97
			Total	749	1,369

The further development of the native industry may be confidently expected in all cotton districts below the 2,000 ft. contour line, although adverse climatic conditions will occasionally prove a hindrance. There are excellent prospects of increased production in the region from Liwonde to Karonga (with the exception of the West Nyasa district). Considerable interest is now being taken in cotton cultivation in the Lake areas, and the demand for seed has greatly increased. In order to assist development the services of additional native instructors and agricul-

turists are required. It is also considered that improvement could be effected by the adoption of a definite rotation of crops and by encouraging the use of oxen and light ploughs for cultivating.

Uganda.—An account of the progress of the cotton industry in Uganda during 1924 is given in the *Ann. Rep. Dept. Agric., Uganda Protectorate, for the Year ended 31st December,* 1924. The area planted by the natives in each of the four provinces was greater than that of the previous year, as shown by the following figures :

	1923. *Acres.*	1924. *Acres.*
Eastern Province . .	298,070	355,500
Buganda Province . .	107,239	185,000
Northern Province . .	10,200	26,114
Western Province . .	3,100	6,200
Total . .	418,609	572,814

The area devoted to cotton in European plantations amounted to only 325 acres, of which 119 acres were interplanted with coffee, whilst 235 acres were planted by Indian agriculturists.

The climatic conditions ruling during the growth and harvesting of the 1923–4 crop were generally very favourable, and as a result the exports of cotton in 1924 reached the high figure of 128,604 bales (of 400 lb. each), of value £3,486,565. The following export statistics for the years 1920–4 are of interest for comparison :

1920.		1921.		1922.		1923.		1924.	
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bales. 52,186	£ 3,919,453	*Bales.* 81,366	£ 1,281,357	*Bales.* 48,290	£ 877,625	*Bales.* 88,046	£ 2,026,820	*Bales.* 128,604	£ 3,486,565

In order to cope with the increased production, new ginneries are being erected in every province.

Uganda cotton is of good quality, has an average length of $1\frac{1}{8}$–$1\frac{3}{16}$ in., and is well suited to the requirements of the Lancashire industry. More than half the exports, however, go to Bombay, and in 1924 about 35,000 bales were shipped to Japan.

A Central Cotton Board has been established for the following purposes : (1) to advise as to the position and number of central markets ; (2) to consider and advise on applications for the erection of new ginneries ; (3) to

advise generally on all legislation and rules dealing with the cotton industry ; and (4) to advise generally on all matters connected with the welfare of the cotton industry.

The Uganda Department of Agriculture has two main stations for the development of improved types of cotton by selection. One of these is at Serere, in Teso District of the Eastern Province, with a subsidiary station at Simsa, near Soroti in the same district, and the other at Bukalasa, in the Mengo District of Buganda Province. The latter station is still being opened up, but the work has been hindered by the difficulty of maintaining an adequate supply of labour ; various cottons have been grown there to test their adaptability to Buganda conditions, but it has not yet been possible to carry out much systematic selection work.

An account of the work carried out at the Serere Station is given by R. G. Harper, Senior Agricultural Officer, who has also contributed an interesting paper to the pages of the *Empire Cotton Growing Review* (1926, **3**, No. 1, 24). Of the various selections made at the Serere Station, the best results have been obtained with No. N 17. This type produces fine, silky cotton, which is of good strength, very regular and $1\frac{1}{4}$–$1\frac{5}{16}$ in. long ; the ginning yield is 31 per cent. This cotton was the chief variety grown at Serere and Simsa in 1924 and it has also been tested in different parts of the Teso and Lango Districts. Large yields were obtained in all cases, and sufficient seed was accumulated to plant an area of 3,000 acres in Serere County in 1925, which will yield seed for wide distribution in 1926. It is intended to introduce this type into native cultivation and eventually to spread it throughout the Province.

Sisal Hemp

Gold Coast.—Several references have been made in this BULLETIN (1920, **18**, 560 ; 1922, **20**, 312 ; 1923, **21**, 497 ; 1924, **22**, 45) to the Sisal hemp plantation which has been established near Accra by the Gold Coast Government. Further information is given in " Notes on the Sisal Industry," by J. M. Wingate, which has been published in the *Journal of the Gold Coast Agricultural and Commercial Society* (1925, **4**, No. 2, 140).

During the financial year ending March 31, 1925, the labour supply failed, with the result that the fibre-extracting factory had to work half-time for some months. This circumstance raised the cost of production to £27 per ton, whereas with a full supply of labour the average

cost would have been only £18 10s. per ton. During the eight months, August—March, 136 tons of fibre were produced, consisting of 119 tons of 1st Grade fibre, 9 tons of 2nd Grade and 8 tons of tow. The prices realised in England were £40–£43 10s. for 1st Grade, £38–£40 for 2nd Grade, and £30 per ton for tow. The expenses incurred after the fibre leaves the plantation, including ocean freight, brokerage, insurance, warehousing and landing dues, amount to £6 15s. per ton.

The Government have offered to supply suckers to farmers, free of charge, and to purchase the leaves and transport them to the factory. Advice on all matters connected with the cultivation of the plants and the cutting of the leaves can be obtained from Government officers on the Sisal Plantation. It is recommended that farms should be selected near the Sisal Plantation in order to reduce the cost of transporting leaves to the factory. There is a large area of suitable land available in this district which would enable farmers to start on a fairly considerable scale. It is estimated that the cost of bringing one acre into bearing and harvesting the leaves would be as follows: clearing the land, £1; planting, 12*s.*; weeding, £2 5*s.*; cutting, £2 6*s.* 6*d.*; total, £6 3*s.* 6*d.* One acre of Sisal plants should yield 41 tons of leaf during its life, and it is probable that the Government would be able to pay 10*s.* per ton for it. A return would thus be obtained of £20 10*s.* per acre, or a profit of £14 6*s.* 6*d.* for about 2½ months' work. Sisal can be worked at any time of the year and, therefore, need not interfere with the farmer's normal production of food crops.

The opinion is expressed that the most convenient area for a farmer to work would be 9 acres, divided into three equal blocks, one of which should be planted in the first year, one in the second, and one in the third. In the fourth year the first block should be replanted, in the fifth year the second block, and so on in regular rotation.

Rubber

"Mouldy Rot" Disease.—An exhaustive study of "mouldy rot" disease of Hevea in Malaya is given by F. W. South and A. Sharples in *Bull. No.* 37, 1925, *Dept. Agric., S.S. and F.M.S.* This disease, which is caused by the fungus *Sphæronema fimbriatum*, was first reported on a few European plantations in the Seremban district of Negri Sembilan in 1916, and has since spread northwards to Selangor and Perak and southwards to Malacca, Johore and Singapore. The disease was reported from Java in 1921, but has not yet been reported from Ceylon

or India. The earliest signs of an attack are depressed spots or blotches from ¼ to 1 in. above the tapping cut, which spread and join up to form an irregular depressed band parallel to the cut. The diseased tissues rapidly darken and become covered with a very characteristic thick greyish mould, easily distinguishable at a distance of 30 or 40 yards. Later, small black bristles—the necks of the spore cases—may be found rising through the mould. Still later, in 3 or 4 weeks, the diseased tissue rots completely, exposing diseased and discoloured wood and forming wounds similar to those produced by bad tapping. Infection is very easily effected and there seems no doubt that its comparatively rapid spread has been due to the spores being carried by human agency from one estate to another, attached to clothing, tapping tools, cups, etc. Fortunately the disease is easily and cheaply treated and controlled. Painting the diseased parts with a suitable disinfectant is a sure cure, provided that tapping is stopped during the treatment, and the results recorded of experiments conducted with one particular proprietary disinfectant are certainly striking. It is considered that the disease need cause no alarm, but due precautions have been taken by the Department of Agriculture and notification and treatment of the disease have been made compulsory.

Prevention of Mould in Rubber.—Experiments conducted by the Scientific Officers of the Rubber Growers' Association have shown that paranitrophenol is very effective as a mould preventive in sheet rubber, and has no deleterious action on the rubber. Recommendations for its use are given in the *Bull. Rubber Growers' Assoc.* (1925, **7**, 560). Paranitrophenol may be applied either by soaking freshly rolled sheet in the solution or it may be dissolved in the acid used for coagulation. For crêpe rubber, the latter method is more suitable. The material is not readily soluble in water, and plenty of time must be allowed for it to dissolve. After standing, the clear liquor is poured off and care must be taken to prevent any undissolved particles getting into the latex, as dark-coloured specks will result. For this reason the soaking process is safer to use. A 0·1 per cent. solution (approximately 3¼ oz. to 20 gallons of water) is recommended for soaking, the rubber being immersed in it for half an hour (*loc. cit.*, 1926, **8**, 40); soaking for three hours, the period originally adopted, is not necessary. In the coagulating process 1½ oz. of paranitrophenol are dissolved in 10 gallons of water to which 5 oz. of acetic acid have been added, and the mixture is used to coagulate 30 gallons of latex standardised

at $1\frac{1}{4}$ lb. per gallon dry rubber content. The material must not be dissolved in the water used for diluting the latex.

In an article on this subject by T. E. H. O'Brien, published in the *Third Quarterly Circular for* 1925, of the Ceylon Rubber Research Scheme, and reprinted in *Trop. Agric., Ceylon* (1925, **65**, 333), it is recorded that tests carried out in Ceylon show that the use of paranitrophenol in the coagulation process would probably not prove altogether satisfactory in that country, owing to the methods of coagulation practised there. Paranitrophenol has a slight clotting effect on latex and there is a danger that clotting might set in before the latex has been transferred to the pans or troughs which are used in Ceylon, thereby spoiling the appearance of some of the sheets. The soaking method is, therefore, recommended for Ceylon. Tests carried out in the Research Scheme Laboratories, fully confirm the results reported by the Rubber Growers' Association Officers in Malaya as regards the value of paranitrophenol as a preventive of mould.

TOBACCO

Crop Rotation.—Extensive field experiments have been in progress in southern Maryland for several years to determine whether legumes and other soil-improving crops, combined with artificial manures, can be used successfully in applying intensive methods to tobacco culture. The results are recorded in *Journ. Agric. Res.* (1925, **30**, 1095), and show that although tobacco is not especially injurious to the general productiveness of the soil, it is particularly sensitive to the effects of preceding crops, and attempts to apply intensive methods such as turning under nitrogenous crops and applying large quantities of manures are likely to fail. Hairy vetch, crimson clover and rye as soiling crops in continuous tobacco culture have given rather large increases in yield of tobacco during the first few years of the tests. In later years the yields have been very variable, and in wet years less than that of the control plot, while the growth has been uneven and the leaf of poor quality and high nitrogen content. Much the same results have been obtained when crimson clover and cowpeas have been used as soiling crops for tobacco in a two-year rotation with wheat. In a three-year rotation of tobacco, wheat and red clover, both the yield and quality of the tobacco have been more stable and on the average higher than those of the control plot. It is possible, however, that the result is due to the

fact that the land is substantially in a resting condition for the greater portion of the rotation period. None of the cropping systems tested have given results with tobacco equal to those obtained on rested land.

Seed Disinfection.—Experiments have been made by the Department of Agriculture, Rhodesia, to determine the effect on the germination of tobacco seed of treatment with formalin as a means of protection against the bacterial diseases, known as wildfire and angular spot. The results are recorded in *Rhodesia Agric. Journ.* (1925, **22**, 861). In no case was the seed permanently injured by the treatment, but germination was retarded, especially that of small and light seed of low vitality. Whereas 76 per cent. germinated in 8 days and 92 per cent. by the end of 25 days in the case of untreated seed, only 56 per cent. germinated in 8 days and 89 per cent. in 25 days when the seed had been previously treated with formalin.

Forestry and Timbers

Forests of Papua and New Guinea.—In the *Empire Forestry Journal* (1925, **4**, 206) C. E. Lane-Poole, Forestry Adviser to the Australian Commonwealth Government, gives a most valuable and interesting account of a botanical journey through forest regions of Papua and New Guinea. Along the coast line, wherever there are level alluvial deposits, occur rank mangrove forests, consisting chiefly of *Rhizophora mucronata, Bruguiera Rheedii, Avicennia officinalis, Xylocarpus granatum* and *Nipa fruticans.* The last-named occurs in great quantities, and attention is drawn to the desirability of utilising the plant as a source of alcohol (cf. this Bulletin, 1922, **20**, 315; 1925, **23**, 175). Stretches of coast where estuarine conditions do not obtain support a "beach forest" mainly composed of *Barringtonia speciosa, Calophyllum Inophyllum, Sonneratia alba* and *Casuarina equisetifolia.* Above this type of vegetation occurs the typical forest region of the country, viz. the rain forest, containing over 600 large tree species, which is found up to an altitude of 4,000 ft. On a sample plot of 108 acres in the forest of Veimauri, Mr. Lane-Poole noted 69 species of trees of timber dimensions (over five feet in girth) and counted 437 trees which contained on an average 80 cubic feet per tree, or 325 cubic feet per acre. Only six species, however, were in sufficient numbers each to carry over 5 per cent. of the total volume, the trees concerned being melila (*Afzelia bijuga*), damoni (*Dractomelum mangiferum*), kaeda (*Planchonia timorensis*), sihu (*Pterocymbium* sp.), huli and devoru (*Alstonia scholaris*). Of

these, the two first mentioned are the only species of outstanding merit, commercially, as timber trees. Of less frequent trees, a number are of value as timber yielders, medobi ("silky teak") being described as affording a beautiful timber. In drier areas other types of forest occur. Savannah forest is met with, and near Port Moresby contains an Australian type of flora, the main tree species belonging to the genus Eucalyptus. Two species of "paper bark" (*Melaleuca leucadendron*) occur, and also groves of *Casuarina nodiflora*. Along river banks inundated in high floods, ilimo (*Octomelis sumatraensis*) occurs almost in pure forest. This valuable tree is of large dimensions, and the light soft timber has been marketed in this country. A third form of forest comprises a rain forest of the tropical type with an upper storey of *Eucalyptus Naudiniana*, a magnificent species, an average tree felled for milling being stated to yield a log of 136 feet. The foothill forest is described as containing, among other species, an oak (*Quercus Junghuhnii*) and a number of conifers, e.g. *Podocarpus neriifolia, Araucaria Cunninghamii* (hoop pine), *A. Klinkii* and *Dacrydium elatum*. In the mid-forest the most striking trees are the hoop pine, two oaks (*Quercus lamponga* and *Q. spicata*), *Eugenia* spp., and two conifers (*Phyllocladus hypophyllus* and *Podocarpus amara*). The high mountain forest (above 10,000 ft.) consists principally of Podocarpus, Libocedrus, Dacrydium and Phyllocladus, with Eugenia and Calophyllum. The author concludes by formulating in outline a forest policy for the two countries in question, and gives a list of the genera and species collected by him in his tour.

Indian Timbers for Railway Carriage Building.—In a *Report on Certain Indigenous Timbers of India, Burma and the Andamans, considered suitable for Railway Carriage Building*, H. G. Norman White, of the Indian State Railways, gives an account of investigations carried out by him under the auspices of the Indian Railway Board with a view to ascertaining the possibilities of using selected Indian timbers for the construction of rolling stock in place of teak, the high price of which has rendered the question of efficient substitutes one of practical interest.

The investigations were carried out under terms of reference which called for enquiry as to (1) the possibility of using a timber cheaper than teak for carriage work, provided that such timber is subjected to suitable preservative treatment; the effects on timber of the recognised preservative processes; the costs of cheap timbers after

treatment, and their probable durability in carriage bodies, as compared with teak; and (2) the feasibility of reducing timber stocks and obtaining properly seasoned timber by adopting artificial seasoning methods; the effects of artificial seasoning on timber and whether the process is as efficient as natural seasoning; estimates of costs and possible economies resulting from artificial seasoning.

The enquiries showed that over eighty Indian timbers have been suggested as substitutes for teak for railway carriage construction, but, up to the present, experience of these woods by railway engineers has been comparatively small and usually not satisfactory. It was also ascertained that little regular seasoning of constructional timbers for rolling stock has hitherto been carried out in India, and that kiln-drying has not been adopted by the railways. The enquiry resulted in the conclusion that there are ample supplies of Indian timbers other than teak which appear likely to meet the requirements of the railway authorities for the construction of rolling stock, and that practical tests of selected woods, when properly kiln-dried, should be carried out. If these trials proved successful, the installation of kilns in railway workshops, for the treatment of these timbers, should be undertaken without delay. The author suggests that in favourable circumstances there would be a possibility of effecting a saving of from 25 to 75 per cent. of the teak at present employed for the purpose.

The following are some of the more important timbers suggested as more or less suitable for the structural parts of rolling stock in place of teak: gurjun (*Dipterocarpus* spp.), eng (*D. tuberculatus*), kokko (*Albizzia Lebbek*), white siris (*A. Siris*), poon (*Calophyllum tomentosum*), shisham (*Dalbergia Sissoo*), ainee (*Artocarpus hirsuta*), sundri (*Heritiera minor*), and sewan (*Gmelina arborea*); while for internal decorative work of the carriages the following are among those recommended: rosewood (*Dalbergia latifolia*), Andaman padauk (*Pterocarpus dalbergioides*), haldu (*Adina cordifolia*), Andaman marble wood (*Diospyros oocarpa*) and kaunghmu (*Parashorea stellata*). Kanyinbyu (*Dipterocarpus alatus*) is recommended for floorings and partitions and for most purposes in repair work. The genus Lagerstrœmia yields promising woods, e.g. pyinma (*Lagerstrœmia hypoleuca*), which, if found to season well, should be useful for many purposes in carriage work; benteak (*L. lanceolata*) has been successfully employed for floor boards and seats and is recommended for trial for bottom sides, end bars, rails, panels and mouldings; jarul (*L. Flos-Reginæ*) appears to be a promising wood for framing.

The author is of opinion that the most important question in regard to the construction of railway carriages in India is the possibility of reducing timber stocks and obtaining properly seasoned wood by artificial seasoning. He considers that kiln-seasoning trials at Dehra Dun, Bareilly and Rangoon show that many woods other than teak can be rendered suitable for the purpose when properly seasoned, and that, as experience with kiln-seasoning increases, additional timbers will also be found serviceable. It is suggested that, ultimately, it should be possible to reduce the quantity of teak used in carriage construction by 25, 50 or even 75 per cent., with a corresponding saving of Rs. 13,81,708, Rs. 27,63,416, or Rs. 41,45,124, respectively, per annum.

It may be mentioned that the author refers to the results of the trials made by the Imperial Institute Advisory Committee on Timbers with a number of Empire timbers with a view to testing their suitability as substitutes for foreign woods in motor body construction, to which reference is made in this BULLETIN (1924, **22**, 149). In these trials entirely satisfactory results were obtained with the following Indian timbers: gurjun, white mahogany (*Dysoxylum glandulosum*), white chuglam (*Terminalia bialata*), and white bombwe.

British Honduras Secondary Timbers.—In connection with the report on the mechanical strengths and working properties of certain British Honduras timbers published in this BULLETIN (1923, **21**, 569), the following information regarding Santa Maria and Banak, extracted from an account of "Some Secondary Timbers of British Honduras" by Duncan and Neil S. Stevenson (*Tropical Woods*, No. 4, December 1, 1925), will be of interest.

Banak (*Myristica panamensis*, Hemsley = *Virola panamensis*, Warb.) is the most important secondary timber now being exploited in British Honduras. The tree grows fairly abundantly on granite and rich porous soils in the district south of the Sibun river. A typical though not fully matured tree gave the following measurements: total height, 115 feet; distance to first branch, 70 ft.; girth above buttresses, 8 feet; height of buttresses, 7 ft. The trunk is straight and cylindrical and would appear to be usually free of branches for 50 ft. or over; the average volume per log is 300 ft. B.M. Exploitation of banak was commenced by the Tidewater Lumber Company in September 1924, and considerable quantities of logs have been exported. The principal use of the timber is understood to be for veneers.

Santa Maria (*Calophyllum Calaba*, Jacq.) is probably the commonest large tree in the mixed rain forests of British Honduras. It reaches a height of 120 ft. and usually has a clean, straight bole, commonly reaching 50 ft. in length and 24 in. square. The tree is of special interest as being one of the chief suppressing rivals of mahogany. Three classes of timber are recognised, viz., "white" and "red," which are very light in colour or pink, and "dark," which is reddish; the two former are floatable, the latter sinks. No method of distinguishing the classes before felling has yet been found. The timber is being cut by the Tidewater Lumber Company for export. One or two cargoes were shipped to Hamburg just before the war and are said to have found a good market.

Another important secondary timber of British Honduras is yemeri (*Vochysia hondurensis*, Sprague), which is known under a variety of names, including "white mahogany." The tree occurs throughout the Colony and grows in almost pure stands on the sandy clay mud soils of the coastal districts. A young specimen measured 110 ft. high, with a bole 72 ft. clear to the first branch, and a girth of 7¼ ft. at 4½ ft. from the ground. "White" and "red" varieties of timber are distinguished after felling, the former being less durable, and difficult to work. The red variety is easy to work and is suitable for the same purposes as poplar. As in the case of the two species previously mentioned, red yemeri is being cut and exported by the Tidewater Lumber Company.

The Antiseptic Treatment of Timbers in India.—The results of "semi-field" observations, extending over 14 years, on timbers treated by means of various antiseptics are summarised in *Indian Forest Bulletin No.* 64 (*Economy Series*) (1925). It follows the work on methods of antiseptic treatment described by R. S. Pearson in *Indian Forest Records* (1912, **3**, Part II, and 1918, **6**, Part IV). The subjects of the observations included twelve different woods ranging from very soft to very hard woods, viz.: *Boswellia serrata*, *Pinus longifolia*, *Pinus excelsa*, *Picea Morinda*, *Abies Pindrow*, *Pterocarpus macrocarpus*, *Bombax malabaricum*, *Bauhinia retusa*, *Dipterocarpus tuberculatus*, *Anogeissus latifolia*, *Odina Wodier*, and *Shorea robusta*. A number of different treatments had been employed, many of them with proprietary preparations.

The pieces of wood, in the form of stakes, 18 × 2 × 2 inches, were fixed upright in the ground, and after varying numbers of years their conditions were observed in

comparison with similar pieces of untreated wood. The ground was known to be infested with white ants.

The results obtained cannot be regarded as definitely conclusive as between the different processes, but some general results seem to emerge from the observations recorded.

Powellising has proved generally satisfactory. The records so far available are not exhaustive, but it is possible to state that in the case of most of the softer woods and some of the harder woods, their lives were considerably prolonged by this treatment, and it is considered that powellising is likely to have a future in India. The process is less expensive than treatment with coal tar creosote.

Coal tar creosote preparations have proved more effective than salt solutions, in spite of the high toxic value of most of the latter that were used, owing to the fact that the salts are leached out by excessive moisture. The salt solutions used include sodium fluoride and zinc chloride in admixture, and certain proprietary preparations. It is suggested that such solutions may prove useful in dry districts, such as the arid regions of Sind and parts of the Punjab.

Earth oils (petroleum) appeared to have a good water-proofing effect and in view of their low cost their use in admixture with coal tar creosote is advocated.

Experiments in the antiseptic treatment of railway sleepers made of Assam timbers are described in *Indian Forest Records* (*Economy Series*) (1925, **11**, Part X). Seven different timbers were employed, viz. *Cynometra polyandra*, *Dipterocarpus pilosus*, *Shorea assamica*, *Dillenia indica*, *Bischofia javanica*, *Terminalia myriocarpa*, and *Lagerstrœmia Flos-Reginæ*. Two processes were employed, viz. the Lowry and Full Cell processes, and the antiseptics used were coal tar creosote and mixtures in various proportions of coal tar creosote and earth oil.

The amenabilities to treatment of the various timbers are deduced from the amounts of absorption of the antiseptics, and conclusions are drawn as to the treatments likely to be most desirable for different timbers, the economic optimum degree of treatment, etc.

It is pointed out that the economically ideal treatment in any particular case is one that will protect the sleeper from decay for just so long as it will endure mechanically. Final conclusions as to the precise treatments which are the best for particular timbers must, therefore, be reserved until the results of exhaustive comparative tests of durability under service conditions have become available.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, December 1925–February 1926.

AGRICULTURE

General

Scientific Reports of the Agricultural Research Institute, Pusa, 1924–5. (Including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugar-cane Expert, and Secretary, Sugar Bureau.) Pp. 163, 9½ × 6¾. (Calcutta: Government Publication Branch, 1925.) Price Rs.2, As.4, or 4*s*.

Annual Report of the Department of Agriculture, Bengal, for the Year 1923–4. Pp. 23 + clxxxvi + 6, 9¾ × 6½. (Calcutta: Bengal Secretariat Book Depot, 1925.) Price Rs.3, As.8.

Report on the Operations of the Department of Agriculture, Burma, for the Year ended June 30, 1925. Pp. 34 + xi, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1925.) Price R.1 (1*s*. 6*d*.).

Report on the Operations of the Department of Agriculture, Madras, for the Year 1924–5. Pp. 51 + 5, 9½ × 6¼. (Madras: Superintendent, Government Press, 1925.) Price As. 4.

Report of the Director of Agriculture, Ceylon, for 1924. Pp. 52, 13 × 8¼. *Ceylon Administration Reports for* 1924. (Colombo: Government Printer.)

Annual Report on Agriculture, North Borneo, for 1924. *Supplement to Official Gazette*, November 3, 1925. Pp. 81–86. (Jesselton: Government Printing Office.)

Annual Report of Mycologist and Agricultural Adviser, North Borneo, for 1924. *Supplement to Official Gazette*, November 3, 1925, pp. 87–89. (Jesselton: Government Printing Office.)

Report of the Botanical and Forestry Department, Hong Kong, for the Year 1924. Pp. 17, 9½ × 6. (Hong Kong: Government Printers, 1925.)

Annual Report of the Department of Agriculture, Union of South Africa, for the Year ended June 30, 1925. *Journ. Dept. Agric., Un. S. Afr.* (1925, **11**, 471–636.)

Annual Report of the Agricultural Department, Zanzibar, for the Year 1924. Pp. 35, 9¾ × 6¼. (Zanzibar: Government Printer, 1925.)

Report of the Minister of Agriculture, Canada, for the Year ended March 31, 1925. Pp. 117, 9½ × 6½. (Ottawa: King's Printer, 1925.) Price 25 cents.

Report on the Department of Agriculture, Barbados, 1924–5. Pp. 28, 12¼ × 8¼. (Barbados: Government Printers, 1925.)

Annual Report of the Department of Science and Agriculture, Jamaica, for the Year ended December 31, 1924. Pp. 42, 13 × 8¼. (Kingston: Government Printing Office, 1925.)

Report on the Agricultural Department, St. Vincent, for the Year 1924. Pp. 46, 13 × 8¼. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1925.) Price 6*d*.

Annual Report of the Department of Agriculture, Western Australia, for the Year ended June 30, 1925. Pp. 37, 13 × 8¼. (Perth: Government Printer, 1925.)

Septième Rapport de la Station Agronomique de la Guadeloupe, 1924–5. Pp. 63, 9 × 6. (Pointe-à-Pitre: A. and J. Lautric, 1925.)

Report of the Secretary, United States Department of Agriculture, 1925. Pp. 105, 9 × 6. (Washington: Government Printing Office, 1925.) Price 10 cents.

Report of the Chief of the Bureau of Plant Industry for the Fiscal Year ended June 30, 1925. *U.S. Dept. Agric.* Pp. 36, 9 × 5¾. (Washington: Government Printing Office, 1925.)

Twenty-fourth Annual Report of the Bureau of Agriculture, Philippine Islands, for the Year ending December 31, 1924. Pp. 284, 10 × 7½. (Manila: Bureau of Printing, 1925.)

Report of the Porto Rico Agricultural Experiment Station, 1924. Pp. 29, 9 × 6. (Washington: Government Printing Office, 1926.)

Natural Enemies of Prickly Pear and their Introduction into Australia. By W. B. Alexander. *Bull. No.* 29, *Commonwealth Inst. Sci. and Indust.* Pp. 80, 9½ × 6¼. (Melbourne: Government Printer, 1925.)

Triennial Review of Irrigation in India, 1921–4. Pp. 27 + 43, 9½ × 6¼. (Calcutta: Government of India Central Publication Branch, 1925.) Price R.1 (1*s.* 9*d.*).

Report on the position and activities of the State Service of Irrigation in the Egyptian Government, with special reference to its relations with other Government Services, and the most promising programme of work for the agricultural development of the country, June 1923. By C. E. Dupuis. Pp. vi + 122, 13½ × 8½. (Cairo: Government Press, 1925.)

Irrigation Requirements of the Arable Lands of the Great Basin. By S. Fortier. *Dept. Bull. No.* 1340, *U.S. Dept. Agric.* Pp. 55, 9 × 6. (Washington: Government Printing Office, 1925.) Price 10 cents.

The Soil

Alkali Investigations in the Sudan. By A. F. Joseph. *Journ. Agric. Sci.* (1925, **15**, 407–419).

The Mechanical Analysis of Soils. A Report on the Present Position and Recommendations for a New Official Method. By a Sub-Committee of the Agricultural Education Association. *Journ. Agric. Sci.* (1926, **16**, 123–144).

Valeur fertilisante de divers engrais. By P. Braemer. *Bull. Econ. Indochine, N.S.* (1925, **28**, 459–473).

"Arab Manure." By F. Menchikowsky. *Circ.* 5, *Agric. Exp. Sta., Inst. Agric. and Nat. Hist., Palestine.* Pp. 22, 9 × 6. (Tel-Aviv: 1925.) [In Hebrew, with Summary in English.]

Nitrogen Recuperation in the Soils of the Bombay Deccan, Part I. By D. L. Sahasrabuddhe and J. A. Daji. *Mem. Dept. Agric., India, Chem. Ser.* (1925, **8**, 53–68).

The Available Phosphate in Soils. By E. Vanstone. *Journ. Agric. Sci.* (1925, **15**, 460–465).

Insect Pests—General

Report of the Entomologist, U.S. Department of Agriculture for the fiscal Year ended June 30, 1925. Pp. 35, 9 × 5¾. (Washington: Government Printing Office, 1925.)

Locusts and Locust Campaigns and Insects affecting the Castor Plant. By B. A. R. Gater. *Planter, F.M.S.* (1925, **6**, 110–114).

Dix Insectes nuisibles aux cultures de l'Afrique Occidentale Française. By P. Vayssière and J. Mimeur. *Agron. Col.* (1925, **13**, No. 94, pp. 166–190).

Beverages

Tea Cultivation in Kenya Colony. By J. W. H. Bradshaw. Pp. 34, 9½ × 6¼. (Nairobi: East African Standard, Ltd., 1925.)

Comparative Tea Analyses. An Examination of Chemical Constituents and Cup Characteristics of Typical Growths and Private Brands. By E. M. Bailey. Chemical Signs of Tea Quality. How Analysis may be used to distinguish Good Teas from Poor—Favourable and Unfavourable Components. By O. W. Willcox. *Tea and Coffee Tr. Journ.* (1926, **50**, 39–46).

Helopeltis-Parasieten I. Mermithiden als Parasieten van Helopeltis. By R. Menzel. Mermithids parasitic in the Tea Bug (*Helopeltis antonii*, Sign.) By G. Steiner. *Med. No. XCIV, Proefsta. v. Thee, Dept. Landb., Nijv. en Handel, N.E.I.* Pp. 16, 10½ × 7½. (Batavia: Ruygrok & Co., 1925.)

The Coffee Industry in Kenya. By A. C. Blackall. *Spice Mill* (1925, **48**, 2150–2151).

Colombia as a Coffee Land. By G. Karlstrom. *Tea and Coffee Tr. Journ.* (1926, **50**, 163–165).

The Coffee Borer. By K. Kunhi Kannan. *Planters' Chron.* (1925, **20**, 922–924).

Fungoid Diseases of Coffee in Kenya Colony. By J. McDonald. *Bull. No.* 3, *Dept. Agric., Kenya.* Pp. 17, 9¾ × 6¼. (Nairobi: Uganda Railway Press.)

Britisch-Westafrika als Kakaoland. *Gordian* (1926, **31**, 3373–3377).

The Marketing of Cacao. Successful Co-operative Effort in Trinidad. By C. Y. Shephard. *Trop. Agric., W.I.* (1925, **2**, 289–291).

Der *heutige* Trinidad-Kakao [The *present* Trinidad Cacao]. *Gordian* (1925, **31**, 2996; reprinted with Engl. transl. in *Auslands-Gordian—Foreign Gordian*, 1925, No. VI, pp. 391–397).

L'Origine hybride des Cacaoyers Cultivés. Note by H. Pittier, with observations by A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1925, **5**, 908–915).

The Cacao Beetle. By F. W. Urich. *Bull. Dept. Agric., Trinidad* (1925, **21**, 36–39).

Cereals

Barley: Culture, Uses and Varieties. By H. V. Harlan. *Farmers' Bull. No.* 1464, *U.S. Dept. Agric.* Pp. 32, 9¼ × 6. (Washington: Government Printing Office, 1925.) Price 5 cents.

Report of Proceedings of Third Maize Conference held at Nairobi, 1925. Pp. 36, 9¾ × 6¼. (Nairobi: Uganda Railway Press, 1925.)

Varieties of Maize in New South Wales. By H. Wenholz. *Farmers' Bull. No.* 152, *Dept. Agric., N.S.W.* Pp. 87, 9½ × 6¼. (Sydney: Government Printer, 1925.) Price 1*s.*

Varieties of Maize recommended by the Department of Agriculture, New South Wales, for various districts. *Agric. Gaz., N.S.W.* (1925, **36**, 693–696).

Le Maïs à Madagascar. By C. Rollot. *Bull. Econ. Madagascar* (1925, *Supp. au No.* 1 *et* 2 *Trim.; Partie: Documentation Générale*, pp. , -10).

The Storage of Maize. Its Possibilities in New South Wales. By H. Wenholz. *Agric. Gaz., N.S.W.* (1925, **36**, 799–802).

The Maize Jassid (*Balclutha mbila*, Naude.). By C. P. v. d. Merwe. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 75–77).

Diseases of Maize and Notes on a Parasitic Maize Weed in Kenya. By J. McDonald. *Bull. No.* 4, *Dept. Agric., Kenya.* Pp. 6, 9¾ × 6¼. (Nairobi: Uganda Railway Press.)

Report on the Rice Crop of Siam for the Year B.E. 2467 (1924–25). *The Record* (Oct., 1925, pp. 116–120).

The Economics of Rice and Cotton Cultivation in the Dialah-Liwah. By Khan Sahib A. A. Soofee. *Mem. No.* 10, *Dept. Agric., Iraq.* Pp. 12, 9¾ × 7¼. (Baghdad: Government Press, 1925.)

The Paddy Swarming Caterpillar. *Leafl. No. 32, Dept. Agric., Ceylon.* Pp. 2, 10 × 6¼. (Colombo: Government Printer, 1925.) Price 5 cents.

Wheat Growing in Kenya Colony. By G. J. L. Burton. *Bull. No. 2, Dept. Agric., Kenya.* Pp. 26, 9¾ × 6¼. (Nairobi: Government Press, 1925.)

The Wheat Position in the Union. The late Board of Trade's Survey and Recommendations to the Government. *S. Afr. Journ. Indust.* (1925, **8**, 614–621; 697–703).

Foot-rot Diseases of Wheat in America. By H. H. McKinney. *Dept. Bull. No.* 1347, *U.S. Dept. Agric.* Pp. 40, 9¼ × 6. (Washington: Government Printing Office, 1925.) Price 10 cents.

Sugar

Review of the Sugar Trade in India during the Official Year 1924–5. By W. Sayer. *Supp. to Ind. Tr. Journ.*, December 17, 1925.

Twenty-fifth Annual Report of the Bureau of Sugar Experiment Stations, Queensland. Pp. 79, 13 × 8¼. (Brisbane: Government Printer, 1925.) Price 2*s*.

The Growing of Sugar-cane in the Philippines. By S. Ascuncion. *Circ. No.* 167, *Bur. Agric., Manila; Phil. Agric. Rev.* (1925, **18**, 309–318).

Compilation of Committee Reports for the Third Annual Convention of the Philippine Sugar Association, Manila, P.I., October 5–10, 1925. Pp. 166, 10 × 6¾.

Deterioration of Sugar-cane during its Storage by Windrowing. By Phani Bhusan Sanyal. *Mem. Dept. Agric., India, Chem. Ser.* (1925, **8**, 105–126).

Loss of Sugar by Inversion in Sugar Factories in Northern India and its Prevention by Antiseptic Measures. By C. M. Hutchinson and C. S. Ramayyar. *Bull. No.* 163, *Agric. Res. Inst., Pusa.* Pp. 9, 9¾ × 7¼. (Calcutta: Government of India Central Publication Branch, 1925). Price As.2 (3*d*.).

Sugar-cane Moth Borers (*Diatræa* spp.) in British Guiana. By H. E. Box. *Bull. Entom. Res.* (1926, **16**, 249–266).

Soil Hygiene in its Relation to "Disease" of Cane. By M. Bird. *Journ. Bd. Agric., Brit. Guiana* (1925, **18**, 256–261).

La mosaique de la Canne à sucre. Son apparition aux Antilles. Quelques faits nouveaux. By A. Kopp. *Bull. tech. No.* 1, *Sta. Agron., Guadeloupe.* Pp. 16, 9½ × 6¼ (Reprint from *Rev. Bot. App. et. d'Agric. Col.*, 1925, **5**, 411–417; 519–527).

Le Betterave à Sucre en Afrique du Nord et Spécialement au Maroc. *Bull. Soc. d'Encour. pour l'Indust. Nat.* (1925, **124**, 745–789).

Root Crops

Le Manioc à Madagascar. By M. Luc. *Rev. Bot. App. et d'Agric. Col.* (1925. **5**, 915–920).

Manurial Requirements of the Potato Crop. By Sir John Russell. *Journ. Min. Agric.* (1925–6, **32**, 883–888).

The Manuring of Potatoes: the Rothamsted Experiments. By T. Eden (*loc. cit.*, pp. 889–892).

Lincolnshire Experiments on the Manuring of Potatoes. By J. C. Wallace (*loc. cit.*, pp. 893–899).

The Manuring of Potatoes. Trials in the North of England. By R. W. Wheldon (*loc. cit.*, pp. 899–903).

The Manuring of Potatoes. Summary of Points arising at the Rothamsted Conference. By C. Heigham (*loc. cit.*, pp. 903–906).

Wart Disease of Potatoes (*Synchitrium endobioticum*, Perc.). By E. M. Doidge. *Journ. Dept. Agric. Un. S. Afr.* (1926, **12**, 161–169).

Steam and Chemical Soil Disinfection with special Reference to Potato Wart. By N. R. Hunt, F. G. O'Donnell and R. P. Marshall. *Journ. Agric. Res.* (1925, **31**, 301–363).

Treating Seed Potatoes with Hot Formaldehyde. By R. C. Rose. *Circ. No.* 22, *Univ. of Minnesota, Agric. Extens. Div.* Pp. 4, 9 × 6. (St. Paul: University of Minnesota, 1925.)

The Sweet Potato. By A. J. Pinn. *Agric. Gaz., N.S.W.* (1925, **36**, 785–793).

West Indian Yams. A Descriptive Account of the Varieties under Cultivation in Trinidad and Tobago, with Details of Cultivation, Yields and Profits. By R. O. Williams. *Bull. Dept. Agric., Trinidad* (1925, **21**, 1–26).

Fruits

Packing Deciduous Fruit for Export. By R. J. Bulmer. *Journ. Dept. Agric., Un. S. Afr.* (1925, **11**, 401–404).

Experiments in Cool Storage of Fruit. By D. B. Adam and J. E. Harrison. *Journ. Agric., Victoria* (1925, **23**, 678–681).

Fruit Drying in South Africa. By L. Perkins. *Journ. Dept. Agric., Un. S. Afr.* (1925, **11**, 405–427).

Dried Fruits. Their Standardisation and Preliminary Grading and Culling. By L. Perkins. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 23–32).

The Apple. By H. B. Terry. *Bull. No.* 1 *of* 1925, *Dept. Agric., Un. S. Afr.* Pp. 91, 9½ × 6¼. (Pretoria: Government Printing Office, 1925.) Price 1*s.* 6*d.*

I. Further Investigations into the Causes producing Rosette of Apricot and Plum Trees in the Wellington District [Cape Province]. II. Report on some Preliminary Investigations into the Influences of Alkali Soils on Peach Stocks employed for Apricot and Plum Trees. By R. Marloth. *Sci. Bull. No.* 42, *Dept. Agric.* (*Div. of Bot.*) *Un. S. Afr.* Pp. 30, 9½ × 6. (Pretoria: Government Printing Office, 1925.) Price 3*d.*

Codling-moth in Apricots. Preliminary Report on the Biology of the Codling-Moth and its Control in Apricots, Wellington, during the 1924–1925 Fruit Season. By F. W. Pettey. *Journ. Dept. Agric., Un. S. Afr.* (1925, **11**, 56–65).

Plum and Prune Culture. By J. M. Ward. *Journ. Agric., Victoria* (1925, **23**, 610–618; 662–671; 738–746).

The Nitrogen and Mineral Requirements of the Plantain. By R. V. Norris and C. V. Ramaswamy Ayyar. *Agric. Journ. India* (1925, **20**, 463–467).

The Banana Weevil Borer (*Cosmopolites sordidus*, Chev.). By J. L. Froggatt. *Queensland Agric. Journ.* (1925, **24**, 558–593).

The Plantain Weevil. By F. W. Urich. *Bull. Dept. Agric., Trinidad* (1925, **21**, 40–42).

Bunchy Top in Bananas. Cause and Nature of Disease. Report of Investigation Committee. *Queensland Agric. Journ.* (1925, **24**, 424–429).

International Trade in Citrus Fruits. By D. J. Moriarty. *Comm. Repts.* (1925, No. 52, pp. 745–748).

La Culture du Citron aux Antilles. By M. Millot. *Bull. Econ. Madagascar* (1925, *Supp. au No.* 1 *et* 2 *Trim.; Partie: Documentation Générale*, pp. 12–54).

Philippine Citrus Fruits. By A. H. Wells, F. Agcaoili and M. Y. Orosa. *Phil. Journ. Sci.* (1925, **28**, 453–527).

Scaly Bark (Psorosis) of Citrus Trees. By E. M. Doidge. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 61–67).

The Distribution of the Date Palm. By P. Popenoe. *Geogr. Rev.* (1926, **16**, 117–121).

Raisin-making. Progress Report on Farmers' Co-operative Experiments, 1925. By L. Perkins. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 55–60).

Sultana Drying by the Cold Dip Process. By F. de Castella. *Journ. Dept. Agric., Victoria* (1925, **23**, 716–731).

Fodders and Forage Crops

Ensilage.—VIII: The Future of Silage. By A. Amos. *Journ. Min. Agric.* (1925–6, **32**, 814–822).

A Study of the Process of making Stack Silage. By H. E. Woodman and F. Hanley. *Journ. Agric. Sci.* (1926, **16**, 24–50).

A Study of the Process of making Clamp Silage. By A. Amos and H. E. Woodman. *Journ. Agric. Sci.* (1925, **15**, 444–453).

Trench Silos in Minnesota. By A. Boss, H. B. White and A. J. Schwantes. *Spec. Bull. No.* 100, *Univ. of Minnesota, Agric. Extens. Div.* Pp. 7, 9 × 6. (St. Paul: University of Minnesota, 1925.)

The Sunflower as a Silage Crop. Composition and Yield at Different Stages of Maturity. By W. L. Gaines and W. B. Nevens. *Bull. No.* 268, *Agric. Exp. Sta., Illinois.* Pp. 49, 9 × 6. (Urbana: University of Illinois, 1925.)

Phosphatic Fertilisers as Manures for Grass Lands. By A. B. Adams. *Journ. Agric., W. Australia* (1925, **2**, 2nd Ser., 172–176; 367–371).

A Study of Some Indian Grasses and Grasslands. By W. Burns, L. B. Kulkarni and S. R. Godbole. *Mem. Dept. Agric., India, Bot. Ser.* (1925, **14**, 1–57).

Chewings Fescue (*Festuca rubra* var. *fallax*). History, Seed-production and Seed-export Problems. By N. R. Foy. *New Zeal. Journ. Agric.* (1925, **31**, 356–370).

Vasey Grass (*Paspalum Larranagai*, Arech.) in Africa. By C. E. Hubbard. *Kew Bull.* (1926, No. 2, pp. 94–96).

The Egyptian Clover (Bersim). By S. Zemach. *Circ.* 8, *Agric. Exp. Sta., Inst. Agric. and Nat. Hist., Palestine.* Pp. 30, 9 × 6. (Tel-Aviv: 1925.) [In Hebrew, with summary in English.]

Subterranean Clover (*Trifolium subterraneum*). By H. A. Mullet. *Journ. Dept. Agric., Victoria* (1925, **23**, 705–715).

Common Alfalfa Insects. By W. Carter and A. G. Ruggles. *Spec. Bull. No.* 100, *Univ. of Minnesota Agric. Extens. Div.* Pp. 8, 9 × 6. (St. Paul: University of Minnesota, 1925.)

Feeding Trials with Velvet Beans. *Rhodesia Agric. Journ.* (1926, **23**, 151–158).

Spices

Cloves.—Clove Harvesting on the Zanzibar Plantations. *Spice Mill* (1925, **48**, 2542–2552).

Oils and Oil Seeds

L'Amélioration de la Production des Matières Grasses dans les Colonies Françaises. Rapport à la Section des Matières Grasses du Conseil Supérieur des Colonies, par E. Baillaud. L'Arachide et le Palmier à Huile en Afrique Occidentale Française. *Bull. Mat. Grasses Inst. Col., Marseille* (1925, Nos. 9–10, pp. 229–262).

Étude Chimique de Quelques Graines Oléagineuses des Pays chauds et, en particulier, des Colonies Françaises. By L. Margaillan, in collaboration with MM. Gontard, Martin, A. Moitessier, and Mlles. Blaquier, Corrieras, Meyer, H. Moitessier and Neyret. *Ann. Mus. Col., Marseille* (1925, **33**, 4e sér., 3e vol., fasc. 2, pp. 5–20).

Pests and Diseases of the Coconut Palm in the Islands of the Southern Pacific. By H. W. Simmonds. *Bull. No. 16, Dept. Agric., Fiji.* Pp. 32, 9¾ × 6½, with 4 col. pl. (Suva: Government Printer, 1925.) Price 3*s*. 6*d*.

Mechanical Processes for the Extraction of Palm Oil. By A. C. Barnes. *2nd Spec. Bull., Agric. Dept., Nigeria.* Pp. 69, 10¼ × 8. (Lagos: Government Printer, 1925.) Price 2*s*. 6*d*., post free.

Experiments on Oil Content of the Seed of the Opium Poppy. By H. E. Annett and M. N. Bose. *Investigations on Indian Opium, No. 5, Mem. Dept. Agric., India* (1925, **8**, 39–43).

L'Industrie des Pépins de Raisins. By M. J. Bonnett. *Bull. Mat. Grasses, Inst. Col., Marseille* (1925, No. 8, pp. 198–210).

The Soy Bean in Ohio. By L. E. Thatcher. *Bull. No. 384, Ohio Agric. Exper. Sta.* Pp. 38, 9 × 6. (Wooster, Ohio: 1925.)

Le Grand Soleil, ou Tournesol. By J. Pieraerts. Pp. 14, 9½ × 6¼. (Brussels: Goemaere, 1925. Reprint from *Rev. Gén. de la Col. belge,* Sept. 1925.)

Essential Oils

La Culture du Laurus Camphora en Algérie. By L. Musso. *La Parfumerie Moderne* (1926, **19**, 4–10).

Fibres

Report on the Chemical Examination of Fibre from the Bark of Terap (*Artocarpus Kunstleri*), Tutor (*Hibiscus macrophyllus*) and Baru (*Hibiscus floccosus*). By R. O. Bishop. *Malayan Agric. Journ.* (1925, **13**, 382–386).

Note on Banana Fibre. By R. O. Bishop. *Malayan Agric. Journ.* (1925, **13**, 376–381).

Die Rolle des Hanfs im deutschen Wirtschaftsleben. By J. Freudenthal. *Faserforschung* (1926, **5**, 61–146).

The Kapok Industry. The Fibre's Origin and Uses. *Netherlands Indies Rev.* (1925, **6**, 254–255).

Over Kapokvervalsching met Katoen. *Berichten van de Afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut.* No. 19. Pp. 7, 8½ × 5½. (Reprint from *Indische Mercuur,* December 25, 1925.)

Roselle. (*a*) Eenige gegevens over Rosellevezel; vezameld door de Afd. Handelsmuseum; (*b*) De Roselle-cultuur in Nederlandsch-Indië en hare perspectieven; voordracht gehouden op October 23, 1925, in het " Koloniaal Instituut," door G. F. van der Meulen. *Berichten van de Afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut.* No. 23. Pp. 44, 8½ × 5½. (Reprint from *Indische Mercuur,* October–November 1925.)

Die Rosella-Pflanze (*Hibiscus sabdariffa*), ihr Anbau und ihre Verwertung. By C. Ettling. *Tropenpflanzer* (1926, **29**, 2–23).

Eri Silk Worm Rearing. By M. N. De. *Bull. No. 6, Dept. Indust., Bihar and Orissa.* Pp. 11, 10 × 7. (Patna: Superintendent, Government Printing, 1925.) Price As.3.

Notes on the Sisal Industry [of the Gold Coast]. By J. M. Wingate. *Journ. Gold Coast Agric. and Comm. Soc.* (1925, **4**, 140–142).

Cotton

Cotton Ginning. By G. S. Meloy. *Farmers' Bull., No. 1465, U.S. Dept. Agric.* Pp. 27, 9 × 6. (Washington: Government Printing Office, 1925.) Price 5 cents.

Co-operative Marketing of Cotton. By G. O. Gatlin. *Dept. Bull. No. 1392, U.S. Dept. Agric.* Pp. 48, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Report on the Cotton Breeding Operations in Queensland. By W. C. Wells. *Queensland Agric. Journ.* (1926, **25**, 31–39).

Comparative Trials with Ratoon and Annual Upland Cotton carried out by the Queensland Department of Agriculture in 1924–5. By G. Evans. *Queensland Agric. Journ.* (1925, **24**, 523–532).

Cotton-growing Prospects in Fiji. By G. Evans. *Emp. Cotton Grow. Rev.* (1926, **3**, 1–14).

Oomras Cotton: the Problem of the Short Staple. By W. Youngman. *Emp. Cotton Grow. Rev.* (1925, **2**, 309–316; 1926, **3**, 15–23).

The Relative Importance of Insect Damage as a Factor in Inhibiting the Production of Cotton in Southern Nigeria. By A. W. J. Pomeroy. *Emp. Cotton Grow. Rev.* (1926, **3**, 36–39).

A Review of the Work of Cotton Seed Selection in Uganda: Years 1911–1925. By R. G. Harper. *Emp. Cotton Grow. Rev.* (1926, **3**, 24–35).

Spinning Tests of St. Vincent Sea Island Cotton. By L. H. Burd. Pp. 8, 8 × 5½. (Kingstown, B.W.I.: Government Printing Office, 1925.)

Production of Acala Cotton in the San Joaquin Valley of California. By W. B. Camp. *Dept. Circ.* 357, *U.S. Dept. Agric.* Pp. 23, 9 × 6. (Washington: Government Printing Office, 1925.) Price 10 cents.

La Production Cotonnière en Afrique Occidentale. By M. Etesse. *Agron. Col.* (1925, **13**, No. 94, pp. 149–165; No. 95, pp. 206–222).

A Machine for Treating Cotton Seed with Sulphuric Acid. By J. G. Brown and F. Gibson. *Bull. No.* 105, *Arizona Agric. Exper. Sta.* Pp. 11, 9 × 6. (Tucson: University of Arizona, 1925.)

The Pink Boll Worm. By E. Ballard. *Queensland Agric. Journ.* (1926, **25**, 23–30).

Seasonal Variation in Pink Boll Worm Attack on Cotton in Egypt in the Years 1916–24. By C. B. Williams. *Bull. No.* 67 *Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 12, 10¾ × 7¼. (Cairo: Government Press, 1926.) Price P.T.5.

Cotton Stainers. By E. Ballard. *Queensland Agric. Journ.* (1926, **25**, 53–55).

A Trinidad Cotton Pest (*Sacadodes pyralis*). By C. L. Withycombe. *Trop. Agric.*, W.I. (1925, **2**, 286–287).

Paper-making Materials

Onderzoek naar de bruikbaarheid van eenige Oost-Indische houtsoorten voor de papierbereiding. *Berichten van de Afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut.* No. 24. Pp. 20, 8½ × 5½. (Reprint from *Indische Mercuur*, December 18, 1925).

Valeur Papetière du Palmier "Doum" (*Hyphæne thebaica*, Mart.) de l'Afrique occidentale. By F. Heim de Balsac, M. Cercelet, J. Maheu, G. S. Dagand and R. Heim de Balsac. *Bull. de l'Ag. Gén. des Col.* (1925, **18**, 1038–1045).

Valeur papetière du "Matsia" de Madagascar (*Sporobolus pyramidalis*). By F. Heim de Balsac, J. Maheu, M. Cercelet, G. S. Dagand and R. Heim de Balsac. *Bull. de l'Ag. Gén. des Col.* (1925, **18**, 1244–1254).

Rubber

Third Year-Book of the Institution of the Rubber Industry, 1924. List of Members, Papers, etc., Session 1923–24. Pp. xxxvii + 430, 8½ × 5½. (London: Institution of the Rubber Industry.) Price 5*s.*

Rubber Production in the Amazon Valley. By W. L. Schurz, O. D. Hargis, C. F. Marbut, and C. B. Manifold. *Crude Rubber Survey. Tr. Prom. Ser. No.* 23, *U.S. Bur. For. and Dom. Comm.* Pp. 369,

9 × 6. (Washington: Government Printing Office, 1925.) Price 65 cents.

Rubber in the Netherlands East Indies. (Area, Production and Exports.) *Bull. No.* 21 (*English Edition*), *Centr. Bur. Stat., Dept. Agric., Indust. and Comm., Neth. E. Ind.* Pp. 40, 10¾ × 8¼. (Weltevreden: Landsdrukkerij, 1925.) Price 2*s*.

De toekomst van de Bevolkingsrubber in Nederlandsch-Indië. Voordracht gehouden op 27 November 1925 in het Koloniaal Instituut. By A. A. L. Rutgers. *Kon. Vereeniging Koloniaal Instituut.* Pp. 19, 9 × 6. (Reprint from *Indische Mercuur*, November 27, 1925).

La Contribution de l'Indochine à l'Évolution dans l'Exploitation des Plantations d'Hévéas. By MM. E. Giraud, P. Bussy, Rochelle et Lambert. *Rev. Bot. App. et d'Agric. Col.* (1925, **5**, 737–745; 845–833; 946–952).

Les Études sur le Caoutchouc et son Industrie. By Jean-Ch. Bongrand. *Chim. et Indust.* (1925, **14**, 823–838).

Studies on Hevea Latex. IV. The Proteins. V. The Possible Occurrence of a Coalescing Enzyme. By W. N. C. Belgrave. *Malaya Agric. Journ.* (1925, **13**, 367–375).

Reports of Tapping Experiments on Estates in Malaya. By A. R. Sanderson. *Bull. Rubber Growers' Assoc.* (1925, **7**, 561–565).

Factors Influencing the Plasticity of Sole Crêpe. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1925, **7**, 716–722).

Formic Acid as a Coagulant. Vulcanising Tests. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1925, **7**, 568–570).

Coagulation with Sodium Silico-Fluoride in Conjunction with Paranitrophenol. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1925, **7**, 657–658).

Ageing Tests on Rubber Coagulated with Acetic Acid and Paranitrophenol. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1925, **7**, 565–567).

Sodium Silico-Fluoride for Coagulating Latex. Recommendations for its Use. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1925, **7**, 555–560).

Smoked Sheet Rubber Coagulated with Acetic and Formic Acids containing Paranitrophenol. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1925, **7**, 612–613).

Para-nitrophenol as a Preventive of Mould on Sheet Rubber. By T. E. H. O'Brien. *Trop. Agric., Ceylon* (1925, **65**, 333–335).

Report on Further Experiments on the Spotting of Crêpe Rubber. By W. Brown. *Bull. Rubber Growers' Assoc.* (1925, **7**, 522–532).

The "Mouldy Rot" Disease of *Hevea brasiliensis* in Malaya. By F. W. South and A. Sharples. *Bull. No.* 37, *Dept. Agric. S.S. and F.M.S.* Pp. 31, 9¾ × 6¼. (Kuala Lumpur: Department of Agriculture, 1925.) Price 50 cents.

Tobacco

Type Classification of American-grown Tobacco. *Misc. Circ. No.* 55, *Bur. Agric. Econ., U.S. Dept. Agric.* Pp. 15, 6¾ × 3½. (Washington: Government Printing Office, 1926.) Price 5 cents.

Roll Tobacco. The Industry in Oudtshoorn and Surrounding Districts. By V. F. Oliver. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 123–131).

Notes on the Growing, Curing and Handling of Virginia Tobacco in Southern Rhodesia. By J. C. W. Andrews. *Rhodesia Agric. Journ.* (1925, **22**, 818–825).

The Quality and Yield of Tobacco as Influenced by Manurial and other Operations. By J. N. Mukerji. *Mem. Dept. Agric., India, Chem. Ser.* (1925, **8**, 1–26).

Fire-curing Tobacco Barn. By the Tobacco Advisers, Department of Agriculture. *Rhodesia Agric. Journ.* (1926, **23**, 33–36).

Formaldehyde Treatment for Bacterial Diseases of Tobacco. By A. C. Newton. *Rhodesia Agric. Journ.* (1925, **22**, 861–862).

Forestry

General

The Forests of Cyprus. By D. J. W. Douglas. *Emp. For. Journ.* (1925, **4**, 235–237).

Progress Report of Forest Administration in Assam, for the Year 1924–5. Pp. 18 + 51 + 2, 13 × 8½. (Shillong: Government Press, 1925). Price R.1 (2*s*.).

Annual Progress Report on Forest Administration in the Province of Bihar and Orissa for the Year 1924–5. Pp. 63 + 3, 13 × 8½. (Patna: Superintendent, Government Printing, 1925.) Price Rs.2, As.5.

Forest Development in Burma. By A. H. M. Barrington. *Emp. For. Journ.* (1925, **4**, 251–260).

Report on the Forest Administration of the Central Provinces, India, for the Year 1924–5. I. Report. Pp. 7 + 33, 9½ × 6½. II. Statements. Pp. lxvii, 13 × 8½. (Nagpur: Government Press, 1926.)

Progress Report on Forest Administration in the Jammu and Kashmir States for the Sambat Year 1981 (1924–5). Pp. v + 53 + xlix, 10 × 6½. (Srinagar: Kashmir Mercantile Press, 1925.)

Annual Progress Report of Forest Administration in the United Provinces, India, for the Period April 1, 1924, to March 31, 1925. Pp. 26 + cxix + 4, 10 × 6½. (Allahabad: Superintendent, Government Press, 1925.) Price Rs.4, As.8.

Annual Report on the Forest Department, North Borneo, for 1924. *Supplement to Official Gazette*, November 3, 1925, pp. 75–80. (Jesselton: Government Printing Office.)

The Forests of Papua and New Guinea. By C. E. Lane-Poole. *Emp. For. Journ.* (1925, **4**, 206–234).

Report on the Forestry Department, Gold Coast, for the Period April 1924—March 1925. Pp. 13, 13 × 8½. (London: Crown Agents for the Colonies.) Price 1*s*.

Annual Report on the Forest Administration of Nigeria for the Year 1924. Pp. 25, 13 × 8½. (Lagos: Government Printer, 1925.)

Forestry Development in South Africa. Suggestions for a Co-operative Scheme between the State and the Landowner. By K. A. Carlson. *S. Afr. Journ. Indust.* (1925, **8**, 676–686).

Forestry Position in Australia. Report (with Summary) by C. E. Lane-Poole. Pp. 12, 13 × 8½. (Melbourne: Government Printer, 1925.) Price 6*d*.

Afforestation Methods in New Zealand. By M. Sutherland. *Emp. For. Journ.* (1925, **4**, 245–250).

Boschexploratie in Suriname. By L. Gonggrijp. *Bull. No.* 48, *Dept. Landb., Nijver., en Hand., Suriname.* Pp. 99, 9 × 6. (Paramaribo: J. H. Oliviera, 1925.)

Tending of Eucalyptus Plantations. By A. S. Thornewill. *Rhodesia Agric. Journ.* (1926, **23**, 29–32).

Pinus insignis, Doug., in South Africa, By N. L. King. *Bull. No.* 15, *For. Dept., Un. S. Afr.* Pp. 30, 9½ × 6. (Pretoria: Government Printing Office, 1925). [Reprinted from *Journ. Dept. Agric.*, July and September, 1925.]

Chir (*Pinus longifolia*) Seed Supply. By S. H. Howard. *For. Bull. No.* 67, *Silvicult. Ser.* Pp. 7, 8½ × 5½. (Calcutta: Government of India Central Publication Branch, 1925.) Price As.3, or 4*d*.

Vergelijking tusschen Engelsch-Indische en Nederlandsch-Indische opbrengstgegevens van den djati (*Tectona grandis*). [A Comparison of British and Dutch Indian Yield-tables for Teak.] By J. A. J. H. Stoutjesdijk. *Tectona* (1925, **18**, 1043–1071; summary in Engl., pp. 1072–1075).

Aantasting van *Tectona grandis* door *Corticium salmonicolor*. By T. Altona. *Tectona* (1926, **19**, 31–51). [Summary in English, pp. 51–53.]

Timbers

Report on Certain Indigenous Timbers of India, Burma and the Andamans considered suitable for Railway Carriage Building, 1924–5. By H. G. Norman White, *Indian State Railways*. Pp. 186, 13 × 8½. (Lucknow: Oudh and Rohilkhand Railway Press, 1925.) Price Rs.3.

A Note on the Working Qualities of some Common Indian Timbers. By H. E. Kinns. *For. Bull. No.* 66 (*Econ. Ser.*). Pp. 43, 9¾ × 7¼. (Calcutta: Government Central Publication Branch, 1925.) Price As.10 (1*s*.)

Notes on the Antiseptic Treatment of Assam Timbers for Railway Sleepers. By J. H. Warr and S. Kamesam. *Ind. For. Rec., Econ. Ser.* (1925, **11**, 283–388).

Some Secondary Timbers of British Honduras. By D. and N. S. Stevenson. *Tropical Woods* (1925, No. 4, pp. 12–16).

Comparison of Types of Kilns suitable for Seasoning Australian Hardwoods. By C. S. Elliott. *Bull. No.* 3, *For. Res., For. Comm. of Victoria*. Pp. 11, 9½ × 6. (Melbourne: Government Printer, 1925.)

Mine Timber. Its Selection, Storage, Treatment and Use. By R. R. Hornor and H. E. Tufft. With a chapter on Methods of Prolonging Life of Mine Timber. By G. M. Hunt. *Bull.* 235, *U.S. Bur. Mines*. Pp. 118, 9 × 6. (Washington: Government Printing Office, 1925.) Price 30 cents.

The Preservation of Mine Timber. Experiments at the Ferreira Deep Mine, Johannesburg. By N. B. Eckbo. *S. Afr. Journ. Indust.* (1925, **8**, 694–696).

Forest Products: 1923. Mine Timber Used Underground. *Bur. of the Census, U.S. Dept. Comm.* Pp. 17, 9 × 6. (Washington: Government Printing Office, 1925.) Price 5 cents. [Contains an Appendix of 4 pp. on Conservation of Mine Timber.]

Gums and Resins

Report on the Kauri-gum Industry, New Zealand, for the Year ended March 31, 1925. Pp. 6, 13½ × 8½. (Wellington: Government Printer, 1925.) Price 6*d*.

Some Notes on Lac Cultivation. By J. W. Nicholson. *Ind. Forester* (1925, **51**, 483–498; 553–564; 605–614).

Cultivation of Lac in the Khasi Hills, Assam. *Ind. Forester* (1925, **51**, 614–615).

Catalogue des Produits de l'Indochine. Les Laques (*Rhus succedanea*, *Melanorrhœa laccifera*, etc.). By C. Crevost. *Bull. Econ., Indochine, N.S.* (1925, **28**, 475–512).

Perubalsem en Tolubalsem in Suriname en op Java. *Berichten van de Afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut, No.* 22. Pp. 16, 8½ × 5½. (Reprint from *Indische Mercuur*, August 28, 1925.)

NOTICES OF RECENT LITERATURE

PAPUA OF TO-DAY: OR, AN AUSTRALIAN COLONY IN THE MAKING. By Sir Hubert Murray, K.C.M.G., Lieutenant-Governor and Chief Judicial Officer of Papua. Pp. xvi + 308, $8\frac{3}{4} \times 5\frac{1}{2}$. (London: P. S. King & Son, Ltd., 1925.) Price 21s.

This book, which is well illustrated, deals in an instructive and at the same time very entertaining way with the general features of the Territory, the life and customs of its people, and the problems which confront the administration. The author manifests a broad-minded sympathy with the indigenous races, and convincingly upholds the application in Papua of the benevolent and adaptable British (or as he calls it " indirect ") method of dealing with native populations in a relatively low stage of development.

THE ARGENTINA OF TO-DAY. By L. E. Elliott, F.R.G.S., F.R.A.I. Pp. xii + 284, $9\frac{1}{4} \times 6\frac{1}{4}$. (London: Hurst and Blackett, Ltd.) Price 18s.

In this interesting volume the author gives an account of a tour of the country which he undertook in 1925, and records his impressions of the changes which have taken place since his last visit five years previously. He draws attention to the fact that there is far more in the Argentine than the strip of flat, neutral-tinted pampa that the average visitor sees. While recognising the dominant place occupied by the lively city of Buenos Aires and its tributary grain and cattle pampa, he points out that the great country of Argentina cannot be judged by these alone.

Special attention is given to the natural resources of the country. The author describes the great cattle, sheep, and wheat-growing industries, the production of quebracho, sugar, maize, cotton and fruit, and the oil-fields of Patagonia and Plaza Huincul.

The book can be recommended to all who desire to know something of a country whose economic history commenced with the Treaty of Amity and Commerce signed by Great Britain 100 years ago, and to whose development British capital has so largely contributed.

THE POLISH HANDBOOK, 1925: A GUIDE TO THE COUNTRY AND RESOURCES OF THE REPUBLIC OF POLAND. Edited by F. B. Czarnomski. Pp. xxxv + 704, $7\frac{1}{2} \times 5$. (London: Eyre & Spottiswoode, 1925.) Price 10s. 6d.

This semi-official publication is full of useful information regarding Poland, and is written in a concise and

interesting style. It deals with history, education, culture, national defence, transport, commerce, industry, and social and political conditions, and a quantity of well-arranged statistical information is provided for students of economics and sociology. The various articles give a convincing picture of the progress of the new Republic in every sphere of activity, and foreshadow great prosperity for its large and increasing population. The book is excellently printed, and can be confidently recommended as a model work of its kind.

PRACTICAL PAPER-MAKING. By George Clapperton. Third Edition. Revised and partly rewritten by R. H. Clapperton, B.A. (Oxon.). Pp. xii + 220, $7\frac{1}{2} \times 5$. (London : Crosby Lockwood & Son, 1926.) Price 7*s*. 6*d*.

This little book, although written as " A Manual for Paper-makers and Owners and Managers of Paper Mills," should be of interest to a much wider circle of readers. It gives a concise account of the various processes involved in paper-making, including preparation and bleaching of the pulp, beating, loading, colouring, sizing, glazing, cutting and finishing. Information is provided regarding the chemical and physical characters of the principal fibrous products used as raw materials, and brief notes are supplied on the microscopical and chemical examination of paper. Some tables are printed in an appendix, giving particulars of weights and sizes of different papers, calculations relating to the weight of reams and webs, figures of the strength and specific gravity of bleaching powder solutions, and other useful data.

The work has been carefully written, contains a number of illustrations, and forms a useful introduction to the larger treatises on paper-making.

THE BLEACHING, DYEING, AND CHEMICAL TECHNOLOGY OF TEXTILE FIBRES. By S. R. Trotman, M.A., F.I.C., and E. R. Trotman, B.Sc., Ph.D., A.I.C. Pp. xi + 610, $8\frac{3}{4} \times 6$. (London : Charles Griffin & Co., Ltd., 1925.) Price 30*s*.

This work is based on a course of lectures given at University College, Nottingham. As indicated by the title, it deals with a wide range of subjects, and in many sections the information is necessarily of a somewhat superficial character.

The book is well illustrated and on the whole appears to have been carefully compiled, but it contains occasional statements which are incorrect or have been drawn from out-of-date sources; e.g. on pp. 93–94 we find the following

remarkable description of Egyptian [illegible]: "There are two kinds of Egyptian, viz. brown a[illegible] The brown variety is finer than the white. . . [illegible]gth of staple and diameter approach those of Sea [illegible]ton, averaging 1·5 to 1·75 in., and 1/1,500 in. [illegible]vely. It can be spun up to 200's. . . . White Egyptian cotton is not so fine as the brown, its staple being not much more than 1 in. in length. It cannot be spun alone to a higher count than 70. White cottons are occasionally arti[illegible]all[illegible] stained to resemble brown Egyptian." Again, on page 1[illegible] under the heading of flax, it is asserted that "The withered stalks contain about 75 per cent. of bast fibres." Apart from such errors, which should be corrected in future editions, the work forms a useful general textbook for textile students.

THE TEXTILE RECORDER YEAR BOOK, 1926. Compiled and edited by Frank Nasmith. Pp. ciii + 960, 7 × 5. (Manchester: John Heywood, Ltd., 1926.) Price *7s. 6d.*

The new edition of this useful work of reference is of the same high standard as that of previous issues. Certain new matter has been introduced, including information on high drafting, linen finishing, preparation of coloured warps for the loom, and the manufacture of artificial silk from viscose. A section is devoted to ropes, cords and twines, and a glossary of the terms used in connection with woollen fabrics has also been added. The statistical matter has been revised and brought up to date.

THE WOOL YEAR BOOK, 1926. Compiled by the Editor of *The Textile Mercury*, in collaboration with various contributors. Pp. cxix + 583, 6½ × 4½. (Manchester: Marsden & Co., Ltd., 1926.) Price *7s. 6d.*

This work forms a handy book of reference on all aspects of the wool trade. It covers a wide range and includes information on the raw materials of the industry, their characters, and the countries of production, and of the various processes employed in the manufacture of woollen and worsted textiles. In the present edition, additional information is supplied regarding artificial silks and their uses in conjunction with wool, and a review of progress in dyeing and finishing during the past year is also given which summarises the more important researches on these subjects that have been published during 1925. The work has been well revised and brought up to date, and will doubtless continue to be of service to those engaged in the various branches of the wool industries.

REIS. By Professor Dr. H. Winkler. Bangerts Auslandsbücherei, Bd. 33, Reihe: Wohltmann-Bücher Monographien zur Landwirtschaft warmer Länder, Band 3. Pp. vi + 138, 7½ × 5. (Hamburg: Deutscher Auslandsverlag Walter Bangert, 1926.) Price RM.5.

This work gives a concise account of the plant and the means of improving it, and describes its cultivation, including such matters as soils and their preparation for the crop, manures, sowing and harvesting. The principal pests and diseases of the plant are dealt with, and information is given on the distribution of the crop in the various countries of the world, and its utilisation. A bibliography is provided.

The book is concisely written, contains a number of useful illustrations, and forms an excellent summary of the whole subject.

PROCESSES OF FLOUR MANUFACTURE. By Percy A. Amos. New Edition, revised by Jas. Grant, M.Sc.Tech. Pp. xii + 311, 7½ × 5. (London: Longmans, Green & Co., 1925.) Price 9s.

The second edition of Mr. Amos's book, published in 1915, has been brought up to date in the present issue by Mr. Grant, who has partially rewritten the chapter on the dry cleaning of wheat and has added an account of the modern Carter Disc Separator. A chapter of 15 pages has been introduced on chemical science applied to flour milling, in which in very few words a scientific explanation has been attempted of mortars, cements, water, the atmosphere and the constituents of the wheat berry. The main body of the book is well known as an excellent textbook for students on the handling of wheat, milling and mill management, and whilst displaying an intimate acquaintance with the practical side of the subject the author does not enter into explanations that involve theoretical, chemical or scientific knowledge.

FRUIT AND THE FRUIT TRADE. By Ford Fairford. Pp. xii + 154, 8½ × 5½. (London: Sir Isaac Pitman & Sons, Ltd., 1926.) Price 6*s*.

This book deals with the fruits that are of general commercial importance, giving a short account of the trade of each, its development and present position. Statistics are occasionally included, and in some instances reference is made to cultivation and marketing. The fruits are divided into the following divisions, each of which forms a chapter of the book: apples, pears, grapes, plums and damsons,

peaches, nectarines and apricots; strawberries and raspberries, melons, minor English fruit, bananas, dates, figs, olives, pineapples, tomatoes, dried and preserved fruits, citrus fruits, and nuts.

PERFUMES, COSMETICS AND SOAPS, WITH ESPECIAL REFERENCE TO SYNTHETICS. By William A. Poucher, Ph.C. Second Edition. Vol. I. Being a Dictionary of Raw Materials. Pp. ix + 304, $8\frac{3}{4} \times 5\frac{1}{2}$. Price 16*s*. Vol. II. Being a Treatise on Practical Perfumery. Pp. xvi + 406, $8\frac{3}{4} \times 5\frac{1}{2}$. Price 21*s*. (London: Chapman & Hall, Ltd., 1925 and 1926.)

A review of the first edition of this treatise, published in one volume in 1923, appeared in this BULLETIN (1923, **21**, 665). Encouraged by the favourable reception accorded to the previous edition, the author has effected a thorough revision and widened its scope, so that the length of the text has been almost doubled, and for convenience the work has now been published in two volumes. As before, it commences with a dictionary of the more important raw materials and miscellaneous substances, including pigments and dyestuffs now used in the perfumery industry. A number of new materials have been added to this list, such as new or lesser known oils and synthetics. The well-known essential oils have been treated more fully, with information as to their application in soap and tobacco perfumery not hitherto supplied. The remainder of the work, now Vol. II, deals as in the previous edition with the preparation of natural and synthetic perfumes and the manufacture of modern cosmetics, but in a large number of instances the information given is more extensive.

This work will undoubtedly prove of great value to the practical perfumer and manufacturer of cosmetics.

THE ECONOMICS OF LEATHER INDUSTRY, WITH SPECIAL REFERENCE TO BENGAL. By B. Ramachandra Rau, M.A., L.T. Pp. vii + 184, $8\frac{1}{2} \times 5\frac{1}{2}$. (Calcutta: Calcutta University Press, 1925.)

The main portion of this book deals with the history, present position and prospects of the leather and allied industries in India, particularly the province of Bengal.

Suggestions are made for reducing the present large export of raw materials and manufacturing them into finished leather goods in India, thereby rendering that country self-supporting as regards leather and enabling it to export the surplus finished leather. Those recommendations are summed up at the end of the book.

The work is furnished with seven appendixes giving information mainly concerning the chamans (native tanners) and mochis (native shoemakers), and also a useful glossary of terms used in the leather industries.

The author has evidently gone to considerable trouble in collecting material for his book, which should prove useful to those interested in the economic side of the leather industries in India.

INDIA OF TO-DAY. VOL. VI. INDIA'S FOREST WEALTH. By E. A. Smythies, B.A. Pp. xv + 137, 7 × 5. Second Edition. (London: Oxford University Press, 1925.) Price 3*s*. 6*d*.

There can be no doubt that this excellent little volume, which contains an introduction by the Inspector-General of Forests, will succeed in its design "to increase public interest in the forests of India." Introductory chapters discuss the relationships between forests, civilisation, and agriculture, and also deal with the history of Indian forests. They are followed by well summarised accounts of the forest regions of the country and the nature, extent and future possibilities of their resources in timber, fuel and other forest products. Almost equal in interest and importance is a chapter on "Minor Forest Produce," which contains accounts of the industries in pine-resin, paper-pulp, tanning materials, essential oils, lac, *Boswellia serrata* gum-resin, drugs, the products of the Bassia tree, etc. In this section reference is made to the value of investigations carried out at the Imperial Institute in regard to manufacturing methods best suited for the distillation of pine resin, and of published articles in the BULLETIN OF THE IMPERIAL INSTITUTE dealing with Bassia products. The book has a number of well-reproduced illustrations, but an index is, unexpectedly, omitted.

THE USEFUL TREES OF NORTHERN NIGERIA. By H. V. Lely. Pp. xii + 128 + 120 full-page illustrations, 10½ × 8½. (London: The Crown Agents for the Colonies, 1925.) Price 10*s*.

This book, which has not been written as a "flora," is intended as a guide to the identifications of the principal trees of the savannah forests of Northern Nigeria. It consists essentially of a series of 120 well-executed line drawings (sketched from living specimens) of the leaves, flowers and fruits of as many species of trees, accompanied by descriptive letterpress arranged in paragraphs dealing with the general characters and habitat of the tree, and the leading features of the bark, wood,

leaves, flowers, fruits and seeds. An account of the uses, if any, to which the different parts of the tree are put is also given. Whenever possible, the use of technical botanical terms has been avoided. A useful table showing graphically the flowering periods of the trees is given as an appendix. The majority of the botanical specimens used in compiling the book have been identified at the Royal Botanic Gardens, Kew, a fact which adds greatly to the value of the work.

The species are described in alphabetical order of their botanical names, but in an appendix they are also arranged under families following the Genera Plantarum of Bentham and Hooker. The information contained in the descriptive paragraphs appears to be of a helpful practical character and in conjunction with the plates (which are conveniently placed facing the letterpress) should be of real assistance in identifying any particular species included in the work.

The book forms a welcome addition to the botanical literature of British West Africa.

MANUAL OF FORESTRY FOR THE NORTH-EASTERN UNITED STATES. Being Vol. I of *Forestry in New England*, revised. By Ralph Chipman Hawley, M.F., and Austin Foster Hawes, M.F. Pp. xii + 281, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1925.) Price 17*s*. 6d.

The awakening of interest in forestry in North America, brought about by the threatened scarcity of some of the most valuable timber trees, has resulted in a great deal of attention being paid to the study of sylviculture and timber, with the consequent accumulation of a considerable technical literature, chiefly in the form of official bulletins. Hitherto the number of serious textbooks dealing with the forestry problems of North America has been strictly limited, and it has been the object of the authors to produce such a work concerned with the specific requirements of the New England States.

The present volume has been written in as simple a form as is consistent with utility, and is intended to be of practical assistance to all classes of landowners, as well as to serve as a textbook for the use of forestry classes in agricultural and other colleges. The plan of the work is on straightforward lines. The first chapter deals with the principles of "sylvics" (forest ecology) and is followed by a useful account of the sylvicultural characteristics of twenty-four important trees grown in New England, the list including three European species, viz. Scots pine (*Pinus sylvestris*), Norway spruce (*Picea excelsa*) and larch (*Larix*

europæa), all of which have been planted with success. Subsequent chapters deal with sylvicultural methods of reproduction and forest management, pests and diseases, forest fires, utilisation of forest products and the growth of trees and forests.

Applied Chemistry. By C. Kenneth Tinkler, D.Sc., F.I.C., and Helen Masters, B.Sc. Vol. II. Foods. Pp. xi + 276, 8½ × 5¾. (London: Crosby Lockwood & Son, 1925.) Price 15*s*.

This second volume, like the first, is intended primarily for students taking the course of Applied Chemistry for the London University degree of B.Sc. in Household and Social Science. It is a laboratory manual of analysis and experiments accompanied by theoretical instruction. The scope of the book is very wide, ranging from the preparation of osazones (with copious formulæ and photomicrographs) to the cooking of cabbages. The subject matter is dealt with under the following heads: milk, edible oils and fats, carbohydrate foods, raising agents, meats, vinegar and fruit juices, beverages, poisons and preservatives, the cooking of food and the calorific value of foods.

Bibliography of Bibliographies on Chemistry and Chemical Technology, 1900–1924. Compiled by C. J. West and D. D. Berolzheimer. *Bulletin No.* 50, *National Research Council*, Vol. IX, Part 3, pp. 1–308. (Washington: National Research Council, 1925.) Price $2.50.

This work is composed of the following sections: General Bibliographies, Abstract Journals and Year-Books, General Indexes of Serials, Bibliographies of Special Subjects and Personal Bibliographies. As the title indicates, the work is a compilation of bibliographies published as separates, or at the end of books or magazine articles, or as footnotes to the same, on the numerous aspects of pure and applied chemistry. Each entry gives name of author or compiler, title, and place of publication. The entries are classified under the proper subject-headings, alphabetically arranged. An approximate analysis shows that there are about 2,400 subject headings, 7,500 author entries and a total of 10,000 individual bibliographies.

Although no claim is made for the completeness of the compilation, the work should furnish a convenient starting point for any bibliographic search.

BOOKS RECEIVED FOR NOTICE

Western Australia: An Official Handbook for the Information of Commercial Men, Migrants, and Tourists. Compiled under the authority of the Government of Western Australia. Pp. 264, $9\frac{3}{4} \times 7\frac{1}{2}$. (Perth: Government Printer, 1925.)

A Trip to Ceylon. By William H. Ukers, M.A. Pp. 38, 10×7. (New York: The Tea and Coffee Trade Journal Co., 1925.) Price 25 cents.

A Trip to India. By William H. Ukers, M.A. Pp. Pp. 38, 10×7. (New York: The Tea and Coffee Trade Journal Co., 1925.) Price 25 cents.

Planting Directory of Southern India. Compiled by H. Waddington. Pp. vi + 274, $8\frac{1}{2} \times 5\frac{1}{2}$. (Coimbatore: The United Planters' Association of Southern India; London: John Bale, Sons & Danielsson, Ltd., 1925.) Price 15*s*.

An Elementary Manual on Indian Wood Technology. By H. P. Brown, Ph.D. Pp. xiii + 121, with 16 plates, $10 \times 7\frac{1}{4}$. (Calcutta: Government of India Central Publication Branch, 1925.) Price Rs.4, or 6*s*. 9*d*.

A Report on the Sugar Cane Mosaic Situation in February, 1924, at Soledad, Cuba. By Edward M. East and William H. Weston, Jr. Pp. 52, $10\frac{3}{4} \times 7\frac{3}{4}$, with 9 plates. (Cambridge, U.S.A.: Harvard University Press; London: Humphrey Milford, 1925.) Price 8*s*. 6*d*.

CONTENTS

VOL. XXIV. NO. 1

PART B.—MINERAL RESOURCES

PART B.—MINERAL RESOURCES.

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Colonial and Indian Governments

---

KAURI PEAT AND OIL FROM NEW ZEALAND

CONSIDERABLE interest has been shown at intervals for many years past in the possibility of utilising the resources of Kauri peat found in the northern part of North Island, for the production of fuel oil and other valuable products.

The so-called Kauri peat, which differs in many respects from true peat, consists of the remains of former Kauri forests and is associated with large roots, trunks and branches. These remains occur in swamps and are, as a rule, covered by a layer of black peat which has been derived from subsequent swamp vegetation. Kauri peat contains variable quantities of gum which in some cases occurs in sufficient amount to make its recovery remunerative. During the past thirty years various companies have attempted to recover oils from the peat, but without the success which the enterprise appeared to warrant.

These efforts have been made chiefly on the Kauri peat from Red Hill in the northern Wairoa district and from Kaimaumau. The vicissitudes of the work have been summarised in the Report of the Commission appointed to enquire into the Kauri-gum Industry (see this BULLETIN, 1922, **20**, 331), in which it was recommended that investigation should be made on the distillation of Kauri peat from various localities and the chemical nature of the products obtained.

Prior to 1923 practically all the ‹ ›tal work on the production of oil from Kauri peat (. exception of certain tests made in the Dominion laboratory) had been carried out by private concerns ; but in that year the High Commissioner for New Zealand requested ‘ʰe ᵀmperial Institute to make a preliminary investigation arding the yield and nature of the oils obtainable from the Kauri peat and Kauri swamp timber. This was done, and the following is a summary of the report furnished to the High Commissioner on the work carried out at the Imperial Institute.

The materials forwarded to the Imperial Institute were as follows :

(1) " KMAU/BP " (referred to as " BP " in this report). A brownish-black, fairly compact peat, containing no visible Kauri gum.

(2) " KMAU/KP " (referred to as " KP " in this report). A friable brown peat, containing a fair quantity of visible Kauri gum and some woody material.

Both these specimens were obtained from the Kaimaumau district.

(3) " REDHILL P."—A brownish-black, fairly compact peat from the Northern Wairoa district, containing very little visible gum. It differed considerably from the Kaimaumau sample.

(4) A sample of swamp timber, from the Northern Wairoa district.

(5) One gallon of Kauri oil stated to have been distilled by a company operating at Kaimaumau.

RESULTS OF EXAMINATION OF KAURI PEATS AND SWAMP TIMBER

Samples of the air-dried peats were crushed and finely ground until all passed a 50-mesh sieve, and this material was used for the proximate analyses and sulphur determinations.

Representative pieces of swamp timber were cut into pieces about ½ in. in diameter, thoroughly mixed, and sampled.

Proximate analyses of the air-dried material are shown

below in comparison with some recorded analyses of air-dried peats from England, Scotland and Ireland.

—	BP.	KP.	Redhill P.	Swamp Timber.	English Peat.[1]	Scottish Peat.[1]	Irish Peat
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Fixed carbon .	34·29	21·77	30·06	23·15	26·9	22·5	26·83
Volatile matter .	50·01	55·50	42·94	67·91	51·8	49·2	49·53
Ash . .	1·66	12·04	11·43	0·56	1·0	2·1	3·44
Moisture . .	14·04	10·69	15·57	8·38	20·3	26·2	20·20
Sulphur (S) :							
Mineral . .	0·07	0·1[illegible]	0·10	—	—	—	—
Organic .	·07	0·43	0·10	—	—	—	—

[1] *J. B. C. Kershaw, "Low Grade and Waste Fuels," p.* 13.
[2] *Fuel Research Board, Technical Paper, No.* 4, *p.* 11.

The volatile matter from the New Zealand samples burned with a smoky luminous flame, that from KP giving the most smoke and greatest luminosity.

The above results approximate to those obtained by J. S. Maclaurin in the Dominion Laboratory, for four samples of peat from Kaimaumau taken at different depths.

Distillation Experiments

Preliminary Trials.—In order to determine the temperature at which the greatest yield of crude oil could be obtained, samples of the crushed peats were heated in an electric furnace at temperatures of 450°, 550°, 650° and 750° C., a slow current of steam being passed through the retort during the distillation in order to facilitate the removal of the volatile products.[1] The condensable products of distillation were collected and the crude oil and aqueous liquor (largely condensed steam) were then separated. The distillation took about 5 hours to complete, the maximum temperature being reached in about 1 to 1½ hours from the commencement.

The yields and specific gravities of the crude oils obtained are shown in the following table :

[1] The effect of passing steam through the retort during the distillation is to increase the yield of gas and crude oil, the latter having a higher specific gravity, and containing a larger proportion of acid constituents than when steam is omitted.

		BP.	KP.	Redhill P.	Swamp Timber.
At 450° C.					
Yield in gallons	per ton	8·3	29·0	8·4	6·0
Specific gravity [1]	. . .	0·961	1·024	1·001	—
At 550° C.					
Yield in gallons	per ton	14·5	37·5	8·5	7·5
Specific gravity [1]	. . .	0·961	1·005	0·995	—
At 650° C.					
Yield in gallons	per ton	15·1	42·4	10·4	7·5
Specific gravity [1]	. . .	0·953	1·018	1·002	—
At 750° C.					
Yield in gallons	per ton	14·4	38·7	8·8	6·0
Specific gravity [1]	. . .	0·962	1·012	1·013	—

[1] *Determined at* 15·5° *C. in each case.*

In each case the yield of crude oil reached a maximum at 650° C. and the sample KP gave the largest quantity.

Proportions of the Oil obtained from the Peat and the Gum respectively

It was considered desirable to determine the relative quantities of oil yielded by the gum and the peat.

For this purpose, the gum was removed as completely as possible by hand-picking and flotation, from a sample of KP. The separated gum, which amounted to 21·4 per cent. of the original peat, was distilled at a temperature of 650° C. under the same conditions as in the preliminary experiments (p. 83) and the yield of oil obtained was equivalent to 26·0 gallons per ton of the original peat (KP). The oil was dark brown, very viscous, and had a pleasant smell and a specific gravity of 1·024 at 15·5° C.

The residual peat, when distilled under the same conditions as above, gave a yield of oil equivalent to 16·2 gallons per ton from the air-dried peat (KP). This oil was dark brown in colour and was more viscous than that obtained from the separated gum. Its specific gravity at 15·5° C. was 1·002.

The total yield of oil from both the gum and peaty portions of KP thus amounted to 26·0 + 16·2 = 42·2 gallons per ton, which is practically identical with the yields already found for this peat (see above).

It is evident, therefore, that in the case of KP the greater part of the oil was derived from the Kauri gum. Assuming that practically all the gum was removed from

KP, as in the above experiment, the residual air-dried material would then yield about 20 gallons of crude oil per ton.

The yield of oil obtainable from peat containing Kauri gum will, therefore, be a variable quantity, depending largely upon the amount of gum present.

The question of the relative values of the small particles of gum recoverable by flotation and of the oil obtainable by allowing them to remain in the peat would evidently need careful consideration.

Distillation of Kauri Peat with Reference to Gas Coke and Sulphate of Ammonia Production

Distillations were made at 650° C. with the three New Zealand peats and the swamp timber by the method of Gray and King,[1] and the quantities of coke and gas obtained at 650° C. are given in the following table :

	Yield of coke.	Calorific value of coke.	Yield of gas per ton at 60° F. (approx.)	Remarks.
	Per cent.	*Calories.*	*Cu. ft.*	
BP . .	43·2	6,919	7,600	Gas burnt feebly with non-luminous blue flame.
KP . .	37·6	5,431[1]	6,440	
Redhill P .	44·3	*	6,780	
Swamp Timber .	35·7	*	6,610	

[1] *This low value is explained by the high percentage of ash* (36) *in the coke.*
* *Not determined.*

All the peat cokes were of a spongy character, and hence would be unsuitable for metallurgical purposes unless briquetted. The coke from BP has a calorific value rather lower than that of average steam coal. The large proportion of ash in the coke from KP would preclude its use for most industrial purposes. The recorded calorific values for peat charcoal vary from about 6,700 to 8,000 calories.

Yield of Ammonium Sulphate.—The yields of ammonium sulphate by the Bailey tube method were as follows :

Calculated per ton of air-dried material.

	lb.		lb.
BP	48·0	Redhill P	47·5
KP	26·5	Swamp Timber . .	6·6

[1] Fuel Research Board, Technical Paper No. 1.

As these determinations were made at a higher temperature than that at which the distillation for oil had been carried out (see p. 83), it was considered desirable to determine the yield of ammonium sulphate in the tube retort at 650° C. (see p. 84). Under these conditions the yield of ammonium sulphate per ton of peat from BP and KP corresponded to 28·4 and 18 lb. respectively.

It is evident that the quantity of ammonium sulphate obtainable under the conditions which furnish the greatest yield of oil will be much less than the maximum possible, and it seems unlikely that it would be remunerative to recover ammonia if the peat is distilled with steam.

The Redhill peat and the swamp timber were not examined in this way, as the former was somewhat similar to BP in its yield of ammonium sulphate by the Bailey tube method, and the swamp timber gave only a small quantity of ammonium sulphate by the same process.

Summary of Distillation Results on Peat and Swamp Timber

The yields of distillation products obtained at the Imperial Institute from the air-dried peats and swamp timber at 650° C. are given in the table on the opposite page, which also includes, for comparison, the results of distillations of other air-dried peats.

These results show that KP gives the highest yield of crude oil. The yields from BP and Redhill P are comparable with the other results quoted, and exceed the limit of 4 per cent. which is stated to be the minimum yield which will render the distillation of a peat economically feasible.

The amounts of ammonium sulphate obtained from the BP and Redhill peats by the Bailey tube method are high.

The yields of paraffin wax from peat are very variable, but that obtained from BP is comparable with that given by Turraun Peat No. 2 (see table, p. 87).

The yields of gas from Turraun Peats Nos. 1 and 2 are very much higher than those given by the Kauri peats probably on account of the temperature and method of carbonisation employed.

	BP.	KP.	Red-hill P.	Swamp timber.	1.[1]	2.[1]	3.	4.	5.	6.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Crude oil . .	6·0	19·2	4·7	3·3	5·6	9·4	2·2	4·0	4·7	9·06
Light oil. Below 150° C. . .	0·1	0·8	*	*	*	*	*	*	*	*
Medium oil. 150° C.–300° C.	2·7	12·4	*	*	*	*	*	*	*	*
Heavy oil. 300° C.–360° C.	2·3	3·2	*	*	*	*	*	*	*	*
Pitch . .	0·9	2·8	*	*	1·9	2·4	0·16	*	0·75	1·6
Coke . .	43·2	37·6	44·3	35·7	26·9	27·0	*	35·0	40·0	35·3
Ammonium sulphate *lb. per ton*	—	—	—	—	29·2	24·8	30·2	*	*	*
Ammonium sulphate (Bailey tube method) *lb. per ton*	48·0	26·5	47·5	6·6	*	*	*	*	*	*
Ammonium sulphate (tube retort method at 650° C.) *lb. per ton*	28·4	18·0	*	*	*	*	*	*	*	*
Paraffin wax *lb. per ton*	14·4	7·3	*	*	8·2	13·7	*	0·9	2·6	6·7
Gas, *cu. ft. per ton*	7,600	6,440	6,780	6,610	14,900	13,760	5,000 to 6,000	*	*	*

[1] *These peats were carbonised in vertical gas retorts, at temperatures of* 980° *C. and* 820° *C. to* 875° *C. respectively.*

* *Not determined.*

(1) *and* (2) *Turraun Peat (Ireland). Fuel Research Board, Technical paper* No. 4, *p.* 16.

(3) *Scottish Briquetted Peat* (*J. A. Greene,* A Treatise on British Mineral Oil, p. 175).

(4) *Peat containing* 20–25 *per cent. moisture* (*Hausding,* Handbook on the Winning and Utilisation of Peat, *p.* 378).

(5) *Bürmoos Peat* (*Hausding,* op. cit., *p.* 448).

(6) *Oldenburg cut Peat* (*Hausding,* op. cit., *p.* 448).

Fractionation of Kauri Peat Oils

(1) *Oil prepared at the Imperial Institute*

In order to obtain, at the temperature of maximum yield (650° C.), sufficient oil for a partial examination, 5 lb. each of KP and BP were distilled separately with steam. The yields of dry crude oil obtained from BP and KP were equivalent to 14·0 and 42·0 gallons per ton respectively, and thus approximate closely to the results obtained in the above preliminary tests. The crude oil yielded by BP was brownish-black and semi-solid, while that derived from KP was a black viscous liquid.

These crude oils were fractionated with the following results :

	Temperature.	Yield. Per cent.	Specific gravity at 15.5°C.	Flash point.	Description of fraction.
BP	Below 150° C.	2·1	*	*	Almost colourless, rapidly becoming reddish.
	150° C. to 200° C.	4·5	*	*	Do.
	200° C. to 300° C.	39·7	*	*	Greenish-brown, wax separating on cooling.
	300° C. to 360° C.	38·5	*	*	Yellowish pasty solid, darkening on standing.
	Residue	15·1	*	*	Black, similar to coke.
KP	Below 150° C.	4·0	0·857	72° F. (22° C.)	Almost colourless, changing to reddish-brown.
	150° C. to 200° C.	6·4	0·934	149° F. (65° C.)	Almost colourless, changing to dark reddish-brown.
	200° C. to 300° C.	58·1	0·957	167° F. (75° C.)	Greenish, changing to very deep reddish-brown.
	300° C. to 360° C.	16·9	*	*	Pasty reddish-yellow substance, slowly changing to black.
	Residue	14·6	*	*	Black solid.

* *Not determined.*

The paraffin wax present in the crude oils from BP and KP amounted to 10·7 and 1·7 per cent. respectively; equivalent to 14·4 and 7·3 lb. per ton of air-dried peat.

(2) *Oil prepared in New Zealand*

(*a*) A sample of Kauri peat oil, prepared in New Zealand, was also fractionated with the results shown below:

Temperature.	Yield. Per cent.	Temperature.	Yield. Per cent.
Below 150° C.	10·8	240° C. to 280° C.	34·7
150° C. to 200° C.	7·8	280° C. to 300° C.	19·4
200° C. to 240° C.	10·8	Above 300° C. (residue)	16·5

The higher fractions darkened on exposure to the air.

The following are results of fractionation tests recorded by J. S. Maclaurin on other samples of Kauri peat oils:

Temperature.	Kauri peat.		Black peat.	Peats from Kaimaumau.			
	Yield per cent.	Specific gravity	Yield per cent.	Yields per cent.			
				(1)	(2)	(3)	(4)
Below 150° C. .	Water 2·0 Oil 5·0	0·858	Water 7·0 Oil 6·0	11·1	11·0	9·6	8·8
150° C. to 200° C	8·9	0·915	2·3				
200° C. to 300° C.	41·5	—	23·9	25·4	30·6	33·2	30·3
300° C. to 350° C.	26·2	0·987	25·9	16·4	15·9	30·1	34·6
Above 350° C. .	13·0	1·012	22·2	41·1	34·7	20·7	15·1
Residue (coke)	*	*	*	6·0	7·8	6·4	11·2
Paraffin wax .	0·5	*	18·9	*	*	*	*

* *Not determined.*

The fractionation products obtained at the Imperial Institute from the samples of Kauri peat oil, show a general resemblance to those from the first oil in the above table, which, however, contains a higher percentage of fractions boiling above 300° C.

The oil prepared at the Imperial Institute from Peat BP approximates fairly closely as regards the yield of the several fractions to the oil from samples (3) and (4), the Kaimaumau peat examined by J. S. Maclaurin (see above).

Chemical Composition of Kauri Peat Oil prepared in New Zealand

This sample was dark brown, and contained a small amount of sediment. The specific gravity at 15° C. was 0·967.

Phenols and Acids.—The phenolic substances and acids present in the fraction of oil distilling below 300° C. (amounting to about 84 per cent. of the crude oil by volume, see p. 88), consisted of a dark, reddish-brown liquid, which amounted to 11 per cent. by volume of the oil distilling below 300° C., or 9·2 per cent. of the crude oil. This liquid, which had a specific gravity of 1·056 at 15° C., was only very slightly soluble in water and had no smell of carbolic acid.

No considerable amount of carboxylic acids was present, and the liquid appeared to consist chiefly of higher phenols.

On distilling the mixture of phen acids the following results were obtained :

Temperature.	Yield by volume.	Yield by volume, calculated on crude oil.	Specific gravity.	Remarks.
	Per cent.	*Per cent.*		
85° C. . .	first drop	*	*	—
Below 150° C. .	7·1	0·65	*	–
150° C. to 200° C.	25·7	2·36	1·039	
200° C. to 225° C.	24·3	2·24	1·040	Light yellow.
225° C. to 250° C.	10·0	0·92	*	Dark yellow.
250° C. to 300° C.	22·9	2·11	1·072	Red and viscous.
Pitch (by difference) .	10·0	0·92	*	Porous black mass.

* *Not determined.*

The fractions boiling between 150° C. and 225° C. gave a faint colour reaction for guaiacol.

The phenolic constituents of Kauri peat oil would probably be suitable for the preservation of wood and the manufacture of disinfectants, but tests of their antiseptic action would be necessary as they apparently contain but little phenol or cresol. It may be mentioned that Morgan and Scharff [1] found that the acidic constituents of the crude oil from an Irish peat had active germicidal properties, and were suitable for the manufacture of antiseptics and disinfectants.

Bases.—The oil from which the phenols had been separated contained approximately 1·0 per cent. of heavy pyridine bases (equivalent to 0·84 per cent. of the crude oil), but this amount was too small for further examination.

Neutral Hydrocarbons.—The neutral oil remaining after the removal of the phenols and bases amounted to about 72 per cent. of the crude oil, and had a specific gravity of 0·903 at 15° C. On distillation by the Engler method, the following fractions were obtained :

Temperature.	Yield by volume, calculated on neutral hydrocarbons.	Yield by volume calculated on crude oil.	Specific gravity.	Remarks.
	Per cent.	*Per cent.*		
85° C. . .	first drop	*	*	—
Below 150° C.	9·8	7·0	0·818	Light brown liquid.
150° C. to 200° C.	15·5	11·2	0·864	Light brown liquid.
200° C. to 250° C.	19·5	14·0	0·901	Pale green liquid.
250° C. to 300° C.	35·5	25·6	0·928	Dark green liquid
300° C. to 350° C.	16·5	11·9	0·948	Brown, viscous liquid.
Residue .	3·2	2·3	*	Brown, wax-like substance.

* *Not determined.*

[1] *Economic Proceedings of the Royal Dublin Society*, 1915, 2, 163 to 166.

The fractions boiling above 200° C. darkened rapidly in the air and appeared to consist largely of unsaturated compounds.

No appreciable amounts of naphthalene or anthracene were present.

The composition of the neutral oil was found to be approximately as follows:

	Per cent.
Saturated paraffins	19
Aromatic hydrocarbons	47
Unsaturated hydrocarbons	34

These fractions may contain small quantities of neutral oxygen and sulphur compounds.

The approximate chemical composition of the crude Kauri peat oil may now be summarised as follows:

		Per cent.
Distillate below 300° *C.*		84·0
Consisting of:		
Water		2·0
Phenolic substances		9·2
Bases		0·8
Neutral Oils (Hydrocarbons)	Saturated paraffins	14·0
	Aromatic hydrocarbons	34·0
	Unsaturated hydrocarbons	24·0
Residue above 300° C.		16·0

The character of the oil obtained from peat depends, to a considerable extent, particularly as regards the hydrocarbons present, on the temperature and other conditions of distillation.

This Kauri peat oil somewhat resembles in composition the crude oil obtainable by low temperature distillation of coal, except as regards the high proportion of aromatic hydrocarbons present, which are probably derived largely from the Kauri gum occurring in the peat.

Kauri Peat Oil as a Fuel for Internal-combustion Engines

As a Fuel for Direct Firing.—Kauri peat oil becomes very viscous when cooled, and it shows a tendency to thicken after standing at 15° C. for half an hour, whilst at 10° C. it partially solidifies. Oil of this character could be used in heavy oil engines, but it would not comply with

the British Admiralty or many other marine specifications for fuel oil, which require that the oil shall be fluid at 0° C.

As a Fuel for Diesel Type Engines.—Specifications usually require that oil for this purpose shall be liquid when maintained at 16·5° C. for half an hour and the crude Kauri peat oil would satisfy this requirement.

The Kauri peat oil is almost completely soluble in toluene, showing only a trace of free carbon. The carbonaceous residue left on driving off the volatile portion of the oil amounts to 2·7 per cent., which is below the limit of 3 per cent. usually suggested as the maximum permissible.

The ash, which consists chiefly of iron oxide and silica, amounts to 0·11 per cent. The maximum limit usually adopted for ash is from 0·05 to 0·08 per cent.

The crude oil could not be used in admixture with alcohol since a deposit is formed on mixing the two liquids.

The investigation at the Imperial Institute has already shown that the oil contains a fair percentage of phenolic substances; but the presence of such compounds in a fuel for heavy oil engines is not harmful in itself, although large amounts of these compounds lower the calorific value of the oil. Since these compounds are of value for the manufacture of disinfectants and for the preservation of timber it is generally more profitable to extract them before using the oil as fuel.

It is probable that the crude peat oil could be adapted for use as a motor fuel oil in Diesel or similar engines consuming heavy oils.

Distillation of the crude oil to produce a light motor spirit might be possible, but the darkening of the distillate on standing and losses on refining would be serious defects.

The calorific value of the fraction of oil boiling below 150° C. obtained from the Kauri peat oil prepared in New Zealand was found to be 10,045 calories, which is about 10 per cent. lower than the minimum results recorded for a number of commercial petrols.

Summary and Conclusions

The results obtained show that the peats and swamp timber, when distilled in steam in an externally heated

horizontal retort, give their maximum yield of crude oil at 650° C., any large variation above or below this temperature causing a marked decrease in the yield. The sample of brown peat from Kaimaumau (KP) gave a much higher yield of oil than either of the other New Zealand peats or the swamp timber.

The oils obtained at the Imperial Institute were much more viscous than the Kauri peat oil received for examination from Kaimaumau, but this may be due to differences in the conditions of distillation.

The yield of oil obtained from KP was much higher than that recorded for numerous peats from Germany and elsewhere. Kauri peat oil differs from the crude oil obtained from ordinary peat in its higher content of aromatic hydrocarbons.

The results recorded in this report indicate that the greater part of the oil is derived from the Kauri gum associated with the peat, and it would thus be essential, in connection with the commercial distillation of peat containing Kauri gum, to determine the relative values of the oils and separable gum.

The yields of oil from BP and Redhill peats are comparable with those recorded for ordinary peats from other sources, and exceed the amount of 4 per cent. suggested as the minimum yield for profitable working.

The yield of oil from the swamp timber is low, and the distillation of the material is unlikely to be remunerative.

The crude Kauri oil would probably be suitable for use as a fuel oil. The oil contains as its principal constituents 34 per cent. of aromatic hydrocarbons, 24 per cent. of unsaturated hydrocarbons, 14 per cent. of saturated paraffins and 9 per cent. of phenolic substances. On account of the unsaturated nature of a large proportion of the oil, refining for motor spirit, etc., would prove wasteful and necessitate expensive plant.

The unrefined motor spirit produced from the crude Kauri peat (see p. 92) had a calorific value about 10 per cent. below that recorded for motor spirit of good quality.

It appears, therefore, that the most economical method of utilising Kauri peat oil would be to sell it locally as a fuel for heavy-oil engines.

The peat coke, remaining after the distillation of the Kauri peat, was spongy and hence unsuitable for metallurgical use unless briquetted. The coke from KP contained about 36 per cent. of ash, which would be a serious obstacle to its industrial use except as a fuel for producer gas plant. The coke from Redhill P was similar to that from KP, whilst that yielded by BP contained much less ash, had a good calorific value and hence would be a useful fuel if briquetted, or it could be completely gasified in a producer gas plant.

The recovery of sulphate of ammonia as a by-product is unlikely to prove remunerative if the peat is distilled in a current of steam.

ARTICLE

CANADA'S MINERAL INDUSTRY

According to official information issued recently by the Department of Mines, Ottawa, the last quarter of a century has been a period of phenomenal growth in the mineral industry of Canada. The value of the mineral production for every fifth year from 1895 to date is as follows:

	$
1895 . . .	20,505,917
1900 . . .	64,420,877
1905 . . .	69,078,999
1910 . . .	106,823,623
1915 . . .	137,109,171
1920 . . .	227,859,665
1925 . . .	224,846,237

The Dominion Bureau of Statistics reports that the production for 1925, as given above, exceeded the value for 1924 by over fifteen million dollars, and came near the record value for the year 1920.

During the last quarter of a century there has been a marked increase in consumption *per capita*. Higher standards of living have been established, and transport facilities improved. Continued improvement in the standard of living and growth of population will be marked by increased industrial activity which will make greater demands on the mineral resources of the country, and a

continued increase in mineral production may, therefore, be expected.

Dealing with this question of future prospects as regards mineral production, the Deputy Minister of Mines remarked recently that the following three factors taken together give an indication of what this future is likely to be : (1) the past performance of the industry ; (2) the great extent of unprospected country ; (3) the increasing world demand for minerals.

During the thirty-year period from 1894 to 1924 the curve of mineral production shows an average annual increase of about $6,300,000 a year. Allowing for a normal increase in population with a consequent increase in consumption, and taking into consideration the fact that a very large proportion of Canada, estimated at about 80 per cent., is as yet unprospected, it is only reasonable to expect that this rate of increase will be continued for some years to come. There is, however, the third factor, namely, the increasing world demand for minerals, that is likely to accelerate greatly the rate of increase in production. No one who has studied the world production and consumption of minerals can fail to be impressed with the force of the circumstances which are ceaselessly increasing the world's mineral consumption and which are compelling the older and more highly developed countries of the world, through the exhaustion of their own natural resources, to look to the newer countries to supply their deficiencies. These circumstances will undoubtedly lead to the quicker and more thorough development of Canada's resources.

Especially among the western nations, world consumption of minerals has increased at a far more rapid rate than the growth of population. According to the best estimates the population of the world during the last forty-five years has grown by about 30 per cent. Within the same period coal production has risen by about 300 per cent., pig-iron output by nearly 300 per cent., copper production by about 1,000 per cent., and petroleum by about 3,000 per cent. A similar rate of growth is apparent in most other industrial minerals, indicating the extraordinary drain that modern civilisation imposes on mineral resources.

The above-mentioned three factors, therefore, justify a well-founded optimism regarding the future of Canada as a mineral-producing country.

Gold

During the last few years, owing to the discovery of new goldfields in Northern Ontario, there has been a steady increase in gold production in Canada. The estimated output of gold in Canada during 1925 was 1,740,386 oz., valued at $35,976,970, as compared with an output of 1,525,382 oz., valued at $31,532,443, in 1924. By far the greater part of this production was obtained from the mines of Porcupine and Kirkland Lake in Northern Ontario, the remainder being obtained chiefly from British Columbia.

According to a recent report by Alfred W. G. Wilson, of the Dominion Department of Mines, the discoveries made in Northern Ontario during 1905–20 have disclosed the most important new gold-producing area found anywhere in the world during the last quarter of a century. These gold mines have returned nearly £8,200,000 to the shareholders, and it is expected that the next few years will see a still larger measure of prosperity.

Ontario's gold output continues to increase. A prominent factor in determining this increase has been the provision of an adequate supply of power for the mines, as a result of which it is expected that output will continue on the up grade.

In British Columbia gold is recovered from placers, from the bullion obtained in milling gold ores, and from the smelter treatment of gold-copper and silver-lead-zinc ores.

In connection with gold mining in Canada, reference should be made to the important work done recently in developing the copper-gold ore deposits of the Rouyn area in North-Western Quebec, which appear to occur under geological conditions much resembling those characteristic of the already known and important mineral areas of Northern Ontario.

According to a recent account of the Horne, which is

the most important mine in the Rouyn district (*Eng. and Min. Journ. Press*, January 16, 1926), two shafts, both in ore, have been sunk. The principal development is from No 1, a 300-ft. two-compartment shaft. The 111 ft. sunk in 1924 was in ore that averaged $44·45 per ton, and consisted of solid sulphides containing 14·69 per cent. of copper and $6·66 gold per ton. A second ore-body, B, 61 ft. in width, was encountered in a cross-cut 40 ft. west of the drive on ore-body A, and a third ore-body, C, 45 ft. wide and averaging $20·48 per ton, was cut at 65 ft. east of the drive on A. Other important discoveries were made on the property, and it is anticipated that by the time railway facilities are provided and the construction of a 500-ton smelter is completed, this and several other mines will have become important.

Silver

According to a recent report by Alfred W. G. Wilson, of the Dominion Department of Mines, Canada's silver mines have yielded the largest outputs of that metal within the Empire for many years past. At the present time she stands third among the world's producers, being surpassed only by Mexico and the United States.

The estimated output of silver in Canada during 1925 amounted to 20,003,970 oz., valued at $13,815,742, compared with an output of 19,736,323 oz., valued at $13,180,113, during 1924.

The mines chiefly responsible for Canada's silver production are those of the Cobalt, South Lorrain and Gowganda districts, all in the province of Ontario. The present production of this area is at the rate of about ten million oz. per annum. During the last twenty years the yield has totalled about 360 million oz., and about £20,530,000 has been returned to the shareholders in dividends.

The remainder of Canada's silver production is obtained chiefly from the lead-zinc ores of Yukon and from silver-lead and gold-silver-copper ores in British Columbia, the present production in the latter province being at the rate of about eight and a half million oz. per annum. In recent years a number of silver-lead prospects were located

in the Yukon, and rich ores are being mined in the Mayo district, where the present yield is about a million oz. per annum.

Lead and Zinc

The mining of lead and zinc ores in Canada has recently been a prosperous business, a state of things likely to continue. The estimated output of lead contained in ore during 1925 amounted to 253,207,987 lb., valued at $23,092,568, compared with an output of 175,485,499 lb., valued at $14,221,345, in 1924. The output of zinc contained in ore for 1925 is estimated at 110,670,981 lb., valued at $8,435,342, compared with an output of 98,909,077 lb., valued at $6,274,791, in 1924.

The production of these two metals in Canada is chiefly in British Columbia, where the Sullivan mine, at Kimberley, is the most important. The mining, milling and power facilities at this mine were enlarged recently, the work being completed in 1924, and the improved equipment had its full effect in 1925, during which year the lead production increased 40 per cent. as compared with 1924. Much progress was made during 1925 in connection with the smelter equipment at Trail, where the capacity of the lead plant has been increased from 190 to 350 tons a day; while the capacity of the electrolytic zinc plant has been increased from 100 to 200 tons a day.

Of the outputs of lead and zinc for Canada during 1925, as mentioned above, it is estimated that British Columbia's output alone amounted to 241,801,155 lb. of lead and 100,205,116 lb. of zinc.

In Eastern Canada, also, there was during 1925 much interest displayed in the economic possibilities of lead and zinc production, and the known deposits of the ores of these metals in Nova Scotia, New Brunswick, Quebec and Ontario, have recently received much attention. In Quebec, the Tetreault mine at Notre Dame des Anges, Portneuf County, is the only one producing lead and zinc. Zinc ore associated with copper has, however, been found in the Rouyn area of Western Quebec, and it seems not unlikely that the developments now taking place in this area will result in zinc production.

According to a recent report by A. H. A. Robinson of the Dominion Department of Mines, the continued high prices of zinc and lead, and the activity of representatives of European smelters searching for new sources of supply in 1925, have aroused considerable interest in Eastern Canada's latent possibilities for increased production of these metals. The more so, as it has become evident that financially powerful American corporations are ready to take advantage of the opportunity afforded by the large quantities of cheap hydro-electric power now available to establish an electro-chemical zinc-reduction plant in Eastern Canada as soon as they can satisfy themselves that sufficient ore to keep such a plant in operation will be forthcoming. As a result of all this, Eastern Canada producers of zinc and lead ores have speeded up development and increased their output; and numerous prospects, old and new, are being explored in search of commercial ore-bodies. In fact, there are very few of the known occurrences of zinc and lead in Eastern Canada that have not been at least examined recently by prospective purchasers or operators.

In Nova Scotia, shaft-sinking is now in progress on the Stirling zinc-lead prospect in Cape Breton Island, and the old Smithfield lead mine near Truro, in Colchester County, is being put in shape for further exploration of the ore-bodies. In Quebec, the British Metal Corporation have made a number of improvements both in their mine and mill at Notre Dame des Anges, that have resulted in a considerably increased output; and further diamond-drilling has been done on the Federal Zinc and Lead Company's mine in Gaspé County, although actual production has not yet been undertaken. In Ontario, the Kingdon Mining, Smelting and Manufacturing Company are preparing further to increase the output of their Galetta lead mine; the old Frontenac lead mine, near Kingston, has been pumped out and examined, as has also the old Wright mine at Lake Timiskaming, where diamond-drilling is now being carried on from the bottom of the old workings; diamond-drilling is also being done in a search for zinc-lead ore bodies just west of Sudbury; and one of the Cobalt mining companies is reported to

be about to start exploratory operations on a zinc prospect near Renfrew.

Copper

The production of copper in Canada has so far been confined to the provinces of British Columbia, Ontario, Quebec, Manitoba and Yukon Territory, although deposits are also known in the Maritime Provinces and in the Canadian Arctic. The total output in recent years has averaged between fifty and sixty thousand tons of blister copper and copper matte per annum, partly refined in Canada.

The output of copper contained in ore in Canada during 1925 is estimated at 111,417,703 lb., valued at $15,645,274, compared with an output of 104,457,447 lb., valued at $13,604,538, during 1924.

In a recent account dealing with progress in copper production in various parts of Canada, A. Buisson, of the Dominion Department of Mines, stated that operations had been started in British Columbia by the Consolidated Mining and Smelting Company of Canada, Limited, in the treatment of the ores which have accumulated at the Company's smelter and of the concentrates received from the Allenby plant near Princeton. After being idle for several years the latter property has been taken over by the Granby Consolidated Mining, Smelting and Power Company, Limited, which, with a milling capacity of 2,400 tons a day, is already handling about 1,000 tons. The Granby Consolidated mines, smelter and mill at Anyox are also working steadily. Part of the ore goes direct to the smelter, and the balance is treated in the mill, which has a capacity of a thousand tons a day. The Britannia Mining and Smelting Company's mines, and the mill at Britannia Beach, have also been operating regularly to the full milling capacity of 2,500 tons. Work has also been resumed at the Kamloops Copper Company's mine at Kamloops, and the smaller operators throughout the Province are also actively engaged.

In the Sudbury region of Ontario great activity has persisted throughout the year. The nickel-copper ores of this area are mined, smelted and partly refined in

Canada. The copper production derived from the treatment of the Sudbury ores will amount to about 20,000 tons for 1925, two-thirds of which will have been refined in Canada, the balance being exported to the United States and Great Britain in the form of blister copper and copper-nickel matte.

In Quebec, operations have been carried on by the Eustis Mining Company at Eustis, with an increased production due partly to the application of an improved method of selective flotation for treating the copper ores. The very encouraging results met with in the development of the Rouyn area of North-Western Quebec, notably at the Horne, the Amulet and the Waité properties, and the assurance of railway and good road facilities, indicate great prosperity for this new mining region. The copper ore discoveries have been accompanied by discoveries of important deposits of gold and of zinc ores. The year 1926 will probably witness the erection of a smelter and possibly milling plants, as well as the construction of a branch railway which will follow a line in proximity to the most important known deposits.

The outlook for increased copper production from Canadian deposits is thus very encouraging. With copper at a reasonably high price, a renewal of operations is expected in the Pas mineral belt in Northern Manitoba, where large deposits have been proved, and it is thought that more intense prospecting and exploration throughout Canada will prove the existence of deposits as yet unsuspected.

Nickel

The nickel-mining industry of Canada continues to prosper, in spite of the reduced demand for the metal in recent years for naval construction. Large stocks of this metal were accumulated as a result of increased mining and smelting activity during the late war, and there was for some time serious reduction in output, from the record figure of 41,298 tons in 1918, to 8,613 tons in 1921, and 7,856 tons in 1922. The nickel-producing companies wisely met this situation by spirited enterprise and large expenditure on research, as a result of which

it was proved that the peace-time use el are quite as important as are its war-time us output, as reported by the Ontario Deputy Mi Mines, rose to 27,704 tons of nickel in 1923 and ns in 1924. The output for 1925 is estimated at 32,700 tons.

According to a recent report by A. H. A. Robinson, of the Dominion Department of Mines, whereas prior to the Washington Conference probably more n per cent. of the nickel produced in Canada was used in e manufacture of armour plates for warships, the larger part is now used in peace-time industries, notably as a component of ferrous and other alloys (especially nickel-steel) ; as a surface coating for other metals ; as a chemical or catalytic reagent ; and as pure malleable nickel for the manufacture of cooking utensils, dairy equipment, and innumerable similar articles made by rolling, forging, pressing or drawing the metal.

At the present time two concerns are responsible for practically the entire output of nickel in Canada. These are the International Nickel Company, with mines at Creighton and Frood ; and the Mond Nickel Company, with mines at Levack and Garson. The Mond Nickel Company is also developing the Frood Extension mine.

The International Nickel Company refines its mattes at Port Colborne on Lake Erie and also exports a part of its product to Huntington, West Virginia, mainly for conversion into monel metal. The Mond matte is shipped to Swansea, Wales, for refining at the Clydach plant. The copper contained in the International matte is recovered as metal, while the Mond method of treatment delivers the copper as sulphate. Important quantities of the precious and rare metals are recovered from the residues of the refining plants.

According to the Deputy Minister of Mines, Ontario, the amount of these precious and rare metals recovered during 1925 from mattes treated in Ontario and Wales are as follows: gold, 4,016 oz.; silver, 134,390 oz.; platinum, 8,692 oz. ; palladium, 7,856 oz. ; and other platinum metals, 432 oz., the aggregate value being $1,675,706.

Canada is by far the largest producer of nickel in the world. Sudbury nickel-ore is being raised and smelted

at the rate of 1½ million tons per year. Moreover, her ore reserves, which are placed at 150 million tons, vastly exceed those of possible competitors. The possession of these large reserves and many other advantages gives the assurance that Canada will retain her predominance as the world's chief producer of nickel for many years to come.

Cobalt

Taking into consideration the near relationship that exists between nickel and cobalt as metals, it is fitting that Canada should be the leading producer of cobalt, as she is of nickel, in spite of the fact that the conditions of occurrence of the two metals are different, and the localities of occurrence are separated, although they are both in Ontario.

The output of cobalt in Canada has been obtained almost entirely from the silver-cobalt-nickel ores of the Cobalt area, which were discovered in 1903 during the construction of the Timiskaming and Northern Ontario Railway. At the present time the only company on the American continent engaged in the reduction of these ores is the Deloro Smelting and Refining Company, Ltd., which operates a completely equipped plant at Deloro, Ontario, where it produces cobalt metal, oxides and salts.

Cobalt metal is employed in making a cobalt-chromium-tungsten alloy which is used extensively for making cutting tools. It is also used in making certain kinds of tool-steels and magnet-steels. The oxide and numerous salts made from the oxides find application in the ceramic and enamel industries and in the manufacture of various pigments. Cobalt salts are also used in electro-plating.

The Bureau of Mines for Ontario reports that the output of cobalt for 1925 was as follows: metallic cobalt, 331,825 lb.; cobalt oxide, 575,580 lb.; cobalt salt and mixed oxides, 265,384 lb.; cobalt in residues exported, 293,473 lb. The amount of cobalt in products marketed during 1925 is reported as 1,116,492 lb., valued at $2,328,517, compared with 948,704 lb., valued at $1,662,526, in 1924.

It is of interest to note, in connection with the fact

that Canada has for some years been the chief source of cobalt, that considerable developments have taken place in the production of cobalt from cobaltiferous copper ores in the Belgian Congo. It is reported that the Union Minière de Haut-Katanga has supplies of raw material sufficient to enable them to control the world's markets. On this account there is some uncertainty as to output and prices of cobalt in the near future.

Asbestos

Canada is the leading producer of asbestos, having supplied between eighty and ninety per cent. of the world's requirements during 1925. The remainder of the world's output was chiefly from countries of the British Empire, notably Rhodesia, Union of South Africa and Cyprus. The only other country of much importance as an asbestos producer is Russia, which country is slowly recovering its pre-war position in the industry.

Asbestos mining in Quebec has grown from small beginnings in 1880, until it is now one of the most important of Canada's non-metallic mineral products. Canadian shipments for 1925 amounted to 259,037 tons, valued at $,8,995,854, as compared with 201,557 tons, valued at $6,710,830, in 1924.

The asbestos is of the chrysotile variety, and is mined in the eastern townships of Quebec, the chief mines being those in the townships of Broughton, Thetford, Ireland and Coleraine. According to A. H. A. Robinson, of the Dominion Department of Mines, most of the output is exported in the unmanufactured condition, chiefly to the United States; but there are now several plants for the manufacture of asbestos goods in Canada, and there will probably be a gradual diminution in the proportion of the output for manufacture abroad.

Until recently, the asbestos industry in Quebec has been handicapped to some extent by strife between the various producing companies. A move was made lately, however, to promote co-operative action, and a number of the more important companies have merged their interests, which will be controlled in future by "The Asbestos Corporation, Ltd." As a result of this merger

it is expected that the corporation will be in a position to centralise control, regulate output and effect economies generally.

Oil Development in Alberta

According to H. S. Hume, of the Geological Survey Branch of the Canadian Department of Mines, prospects for the development of oil production in Alberta have recently appeared more promising than at any previous time, as indicated by the geological conditions and present production in the Turner Valley field, south-west of Calgary, and in the Wainwright field, 120 miles east of Edmonton.

Oil has been struck in three wells at Wainwright, and one of these three wells has been producing satisfactorily. A geological study of the structure in the Wainwright field indicates possibilities of greater production from deeper horizons, and it is expected that drilling will be carried on to test these possibilities.

A small quantity of light oil has been produced by the Turner Valley or Sheep River field for several years; and toward the end of 1924 there was discovered in one well a strong flow of wet gas at a depth of 3,740 feet. The well could not be completely shut in because of the excessive pressure, and the gas is therefore allowed to flow at the rate of 17 million cubic feet a day. Two separators have been erected on the pipe line to extract gasoline from the gas, and during the first six months of 1925 the well produced 423 barrels of gasoline a day. The gasoline is treated at Calgary and the erection of a scrubbing plant to treat the gas was recently under consideration. Other wells have been drilled in this field with satisfactory results, which have given much impetus to the search for other favourable drilling sites, and it is expected that the amount of exploratory work will increase at an early date.

Tests are being made in other parts of the Province. At Medicine Hat the Roth well was being drilled recently, and the Medicine Hat-Redcliffe area has produced a large amount of gas for industrial and domestic use. Much drilling has been done in Southern Alberta following the

discovery of oil a few years ago in the Kevin-Sunburst field of Montana, in the United States, close to the International boundary, but no commercial products have yet been found.

There is a vast area of possibly oil-bearing territory in Canada as yet undrilled, mainly in the prairie provinces and in the Mackenzie River basin. In 1920 oil was struck in a bore-hole 45 miles below Fort Norman on the Mackenzie River.

Other Minerals

Other important minerals produced in Canada include *coal*, *mica*, *felspar* and *talc* or *soapstone*.

Canada's coal resources, which are chiefly situated in Alberta, and which include lignite, bituminous coal and anthracite, are immense, and in 1913 were estimated at 1,234,000 million tons. Of this total, the amount of the better grades—bituminous and anthracitic coals—was 268,000 million tons. This is only exceeded by the reserves of the United States and China.

As regards mica, Canada shares with India the responsibility for the most important part of the world's output. Canada produces the variety of mica known as phlogopite, or amber mica, which is softer, more flexible and a better insulator than muscovite or white mica found generally in other countries.

Canadian felspar is a valuable raw material for ceramic work, being of high grade and of uniform potash content. It is mined on an important scale in Ontario, but it occurs also in Quebec.

Canada also produces talc on an important scale, being the chief producer of this mineral in the British Empire. The mineral is found in Ontario, Quebec, Nova Scotia and British Columbia; but the output is chiefly at Madoc in Hastings County, Ontario, where fine white talc of the highest grade is produced.

NOTES

Recent Mineral Discoveries and Developments in the Gold Coast Colony.—Important work has been carried on for some years past by the Geological Survey of the Gold Coast Colony, British West Africa, under the Directorship of A. E. Kitson, C.M.G., C.B.E., with substantial practical results. Prominent among these results are the discoveries of deposits of manganese ore, diamonds and bauxite.

The deposits of manganese ore were discovered by the Survey in 1914, but were not developed until 1916, in which year 4,016 tons were exported from Insuta, followed by 29,534 tons in 1917. In the last two or three years there have been large increases in the amount exported, the exports in 1924 amounting to 233,401 tons. The ore of the Insuta-Dagwin deposits is of good quality and is specially suitable for the manufacture of ferro-manganese. Much of it is of the exceptionally high grade required by the chemical industry. The analysis of the average ore is as follows:

	Per cent.
Manganese	50 to 53
Iron	2 ,, 4
Silica	3 ,, 7
Phosphorus	0·1 ,, 0·12

These deposits are now being actively worked by the African Manganese Company, the present rate of output being about 360,000 tons per annum. It is estimated that the exports for 1925 from the Insuta mine will amount to about 330,000 tons. The total amount of manganese ore exported from Insuta since 1916, up to and including 1924, is reported as 579,170 tons, valued at £1,074,500.

Diamonds were discovered in the Gold Coast by the Geological Survey in 1919 at Abomoso, near the Birim River in Akim Abuakwa, and diamond mining has been in operation in the Birim Valley since that year. The total recorded yield of diamonds to August 1924 is 64,732 carats, valued at £79,606, and that to the end of June 1925 is 115,000 carats, valued at £153,947, an increase of 77 per cent. by weight and 93 per cent. in value in ten months. The diamonds are of alluvial origin. Most of them are very small, but many of them are from ½ to ¼ carat, and a few larger, of good quality, have been found. The largest reported was 9 carats, but was a poor stone. The gems have a ready sale, as most of them, although small, are of very good quality.

The Geological Survey has discovered several large deposits of bauxite in various parts of the Colony and

Ashanti. The principal deposits are those on Mount Ejuanema, Kwahu, and on Mounts Supirri, Ichinniso and Kanaiyeribo, near Sefwi Bekwai, all in the Colony. The deposits occur chiefly on the summits of the highest flat-topped mountains in the country, where they form caps from ten ft. to upwards of forty ft. in thickness. The quantity of bauxite available on Mount Ejuanema alone is estimated at four million tons. The mean of the analyses of 198 specimens from different parts of the western half of the summit of Ejuanema gives 60·66 per cent. of alumina and 0·88 per cent. of silica. As regards transport facilities, the top of Mount Ejuanema is about 1½ miles in a direct line from Nkawkaw railway station, which is 111 miles distant from the port of Accra by rail, and 249 miles distant from Sekondi via Kumasi. The recent developments in the utilisation of bauxite for the production of lime-alumina cement, and the possibility of the production of this cement for use in the Gold Coast Colony and other parts of West Africa, make these Gold Coast bauxites very interesting from the commercial point of view, quite apart from the fact that they are of high-grade quality as aluminium ores. Investigations are now being made by the Survey for the purpose of ascertaining whether suitable deposits of limestone are available for use together with the bauxite for cement production.

For further particulars on these and other aspects of mineral developments in the Gold Coast Colony, readers should consult a recently published Bulletin (No. 1) of the Gold Coast Geological Survey, entitled, "Outlines of the Mineral and Water-power Resources of the Gold Coast, British West Africa, with Hints on Prospecting," by A. E. Kitson. This bulletin is obtainable from the London Office of the Gold Coast Geological Survey on application to the Director at 29, Alfred Place, South Kensington, London, S.W.7 (price 1*s.* 2*d.*, post free).

Canadian Hydro-electric Power Developments during 1925.— According to information received from the Office of the High Commissioner for Canada, the Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has prepared a bulletin giving a review of hydro-electric and water-power development in Canada during 1925, which shows a record degree of activity in this important industry, the increase in the total installation far exceeding that of any previous year. Approximately 719,000 horse-power was added during the year, bringing the total installation in the Dominion to 4,290,000 horse-power.

This new development represents a direct investment of at least $70,000,000 without regard to new capital required in the application of the power. Projects approaching completion will add more than 250,000 h.p. early in 1926, while others already commenced or in imminent prospect promise a substantial increase in installation in the next few years.

Not only was 1925 of outstanding interest on account of the large increase in installed capacity, but it marked the bringing into operation or completion of a number of large projects which have been under active construction for the past few years.

Quebec led with a total new installation of 439,000 h.p. This increase is largely accounted for by the 360,000 h.p. initial installation of the Duke-Price Power Company at Isle Maligne, on the Saguenay River, to which an extension of 480,000 h.p. was begun recently and was expected to be completed in February. Other projects include that of the Aluminium Corporation on the Saguenay, where an ultimate development of 800,000 h.p. is proposed, and that of the International Paper Company at Chelsea, on the Gatineau River.

In Ontario, the total installation for 1925 was about 200,000 h.p., for which the Ontario Hydro-electric Power Commission was largely responsible. The Queenston-Chippawa plant was brought to its complete capacity of 552,000 h.p. by the addition of two 55,000 h.p. units; and the 75,000 h.p. plant at Cameron Falls, on the Nipigon River was also completed. Other developments include: the 24,000 h.p. extension to the Island Falls plant on the Abitibi River by the Abitibi Power and Paper Company; and the 17,000 h.p. development of the Keewatin Power Company at the Lake of the Woods.

In British Columbia, about 59,000 h.p. was added to the installations. The British Columbia Electric Railway Company has announced a development on the Bridge River, to start probably in 1927, with an installation at the outset of 54,000 h.p. and the ultimate development of nearly 700,000 h.p. In Manitoba, the City of Winnipeg added 21,900 h.p. to its plant on the Winnipeg River, and let two more contracts for two further units for 1926 delivery.

In the Maritime Provinces many extensions and new plants are in prospect. The most important of these is at Grand Falls on the St. John River, in New Brunswick, which is now engaging the attention of the Provincial Government.

The bulletin mentioned above records with a brief

description all the more important power developments under construction during 1925 in each of the Canadian provinces. Copies may be obtained free of charge on application to the High Commissioner for Canada, Canadian Building, Trafalgar Square, London, S.W.1, or to the Director of the Dominion Water Power and Reclamation Service, Ottawa, Canada.

The Petroleum Position in the United States.—The large consumption of petroleum and its products in the United States and the increasing use of these for fuel requirements continue to stimulate much public interest in that country as to the reserves available and the need for the discovery, if possible, of new sources of supply. Research on this subject has recently received much stimulus from the munificence of John D. Rockefeller, who, by making a grant of $250,000, has initiated a fund for promoting scientific research in petroleum. The Universal Oil Products Company of Chicago is reported to have followed Rockefeller's example and has subscribed a similar amount to the fund, which will be administered by the American Petroleum Institute. Much interest is being displayed in this subject by all parties responsible for the production of petroleum in the United States, and as a result of the efforts now being made, a large amount of information is likely to be obtained during the next few years as to petroleum reserves in the United States and the possibility of tapping new sources of supply in that country. Meanwhile, much interest attaches to a report made recently to the American Petroleum Institute by a specially appointed Committee and published under the title of "American Petroleum Supply and Demand" (New York and London, McGraw-Hill Book Company Inc., 1925). The conclusions of the committee are stated to be based on the best information obtainable, within and without the industry, and are summarised as follows:

1. There is no imminent danger of the exhaustion of the petroleum reserves of the United States.

2. It is reasonable to assume that a sufficient supply of oil will be available for national defence and for essential uses in the United States beyond the time when science will limit the demand by developing more efficient use of, or substitutes for, oil, or will displace its use as a source of power by harnessing a natural energy.

3. Current supply and demand cannot stay in balance, since the amount of both supply and demand is constantly changing. Generally, current supply will exceed or be less than current demand, creating surplus or short-

age; either condition will be reflected in price, but price will in time correct either condition.

4. Petroleum recoverable by present methods of flowing and pumping from existing wells and acreage thus proved amounts to five billion, three hundred million (5,300,000,000) barrels of crude oil.

5. It is estimated that after pumping and flowing there will remain in the area now producing and proved twenty-six billion (26,000,000,000) barrels of crude oil, a considerable portion of which can be recovered by improved and known processes such as flooding with water, the introduction of air and gas pressure and mining, when price justifies.

6. Improved methods of deep drilling below oil sands now producing will disclose in many areas deposits not hitherto available, which will be tantamount to the discovery of new fields. Improved methods of producing have been perfected which will make possible recovery of oil from these lower levels. The limit of deep drilling has not been reached.

7. The major oil reserves of the United States lie in some one billion, one hundred million (1,100,000,000) acres of lands underlain by sedimentary rocks, and not fully explored, in which geology indicates oil is possible. With extended search new supplies will be found therein.

8. The nation has an additional reserve in the vast deposits of oil shale, coal and lignites, from all of which liquid fuel and lubricants may be extracted if and when the cost of recovery is justified by the price of these products. These deposits are so huge that they promise, under conservative estimates, an almost unlimited supply.

9. While this report is confined to the petroleum supply and demand within continental United States, the importance of imports cannot be ignored. Countries to the south are known to have large petroleum resources, for the output of which the United States is a natural market and the supply therefrom must inevitably have its influence on the consumption of American reserves.

10. The availability of future petroleum supplies from the vast area of land mentioned above depends upon adequate incentives to the exploration which in the past has given the nation a sufficient supply of petroleum, in peace and in war, throughout the history of the oil industry, from its inception in 1859.

There must be:

(*a*) Security in the ownership of oil lands and of the right to lease.

(*b*) Conditions of exploration and development by

owners or lessees permitting exercise of initiative, liberty of action, the play of competition and the free operation of the law of supply and demand.

(*c*) Prices that will provide a return to producers, refiners and distributers commensurate to the risks involved and the capital invested.

11. The supply of petroleum will be made to go much further through more efficient utilisation. Automotive experts state that the mileage of the motor-car per gallon of gasoline may be doubled through structural mechanical changes, when price justifies such changes. Improved mechanics will also result in smaller consumption of lubricants.

12. Through improved methods, principally the process known as "cracking," the refining branch of the industry has already increased the yield of gasoline, now the major product of petroleum. Through further improvements and extensions the supply of gasoline will be augmented still further by the "cracking" of fuel oil. In consequence the supply of fuel oil will be correspondingly diminished, thus eventually removing fuel oil from competition with coal.

13. Waste in the production, transportation, refining, and distribution of petroleum and its products is negligible.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON MINERAL RESOURCES

The following abstracts of the more important recently published papers and reports on mineral resources relate more particularly to the resources of the Dominions, Colonies and India. The Imperial Institute accepts no responsibility for the opinions expressed by the authors of the papers and reports referred to in these abstracts.

METALS

Aluminium and Bauxite

Canada.—The metal-production plant of the Aluminium Corporation of Canada at Chute à Caron Falls, on the Saguenay River, Quebec, is expected to be completed towards the end of 1928. The hydro-electric equipment being installed will consist of ten 80,000 h.p. turbines, and twenty steamboats will be operating on the Saguenay River to meet the requirements of the company. The bauxite required will all be brought from British Guiana. It is expected that 8,000 men will be employed.

Antimony Oxide

Recent improvements in the manufacture of white antimony oxide (Sb_2O_3) have led to its increased use as a paint material. According to J. G. Bearn in the *Chemical Age* (1925, **13**, Aug. 22, p. 189), variations in colour and texture have hitherto militated against its use as a pigment. Now, however, oxide of antimony is obtainable that is entirely suitable for use in paint manufacture as regards colour, texture and body. This oxide has a specific gravity of about 5·4 and makes a paint approximating in body to that of white-lead paint. Antimony oxide paint is non-poisonous. It differs from ordinary paints in that it is acidic and has no drying effect on linseed oil. It has been found that the addition of from 10 to 25 per cent. of zinc oxide, with about 2 per cent. of cobalt linoleate drier, gives remarkably good results in gloss and hardness of film on drying.

Another use of antimony oxide is referred to in the *Chemical Trade Journal and Chemical Engineer* (1925, **77**, Sept. 25, p. 356). Investigations have been made by Wohlgemuth and Rewald into the use of antimony oxide in the enamelling industry, where it has largely replaced tin oxide in recent years. Experiments on various frits made from a commercial oxide free from arsenic, lead, barium and zinc, led them to the conclusion that such an

oxide is absolutely innocuous even when forming part of glazes on cooking utensils.

Arsenic

In *Engineering and Mining Journal-Press* (1925, **120**, Nov. 14, pp. 765–772), E. H. Robie describes at length the mining, concentration and sublimation treatment at the Jardine Mine, Montana. The minerals of economic importance are gold, arsenopyrite and scheelite, occurring as lenses in mineralised shear-zones in folded Pre-Cambrian schist. The scheelite is not being recovered at present. About 225 tons of ore are mined per day, averaging about $6.33 per ton in gold and 4·91 per cent. of As_2O_3. This is crushed in stamp batteries; it is then passed over amalgamating tables and is afterwards treated by froth-flotation machines. The concentrates are sent to tables (chiefly to break down the froth) and then to settlers whence they are conveyed to McDougall furnaces, the temperature of which is very closely controlled. The sublimed arsenic is collected in suitable chambers and flues. It is either sold in this crude form or resublimed in reverberatory furnaces. Details of furnaces, collecting chambers and costs are given.

The manufacture of arsenical insecticides is described by C. W. Drury and C. W. Simmons in *Canadian Chemistry and Metallurgy* (1925, **9**, Aug., pp. 179–182). Calcium arsenate appears to be most successful in attacking the boll weevil and its use is rapidly extending in that and other directions. Data relating to the arsenic percentages and comparative costs of the different insecticides on the market are shown in the following table:

Product.	Minimum arsenic content.	Cost per lb. of product.	Cost per lb. of As. in cents.	Volume in cub. in. per lb. of product.
Calcium arsenate	27	12	44	80–100
Lead arsenate	20	20	100	70
Paris green	41	30	73	15–20
Sodium arsenate	36	12	33	

The world's potential production of white arsenic is estimated by M. Pagezy, in *Annales des Mines* (1925, VII, Ser. 12, No. 6, pp. 375–407), at about 42,000 metric tons. In an interesting article on the arsenic market and French production, he points out the danger of expecting too great an expansion in the use of insecticides, as they tend to eliminate the insect attacked altogether, thus reducing the necessity for their use. This has been

well illustrated in the case of the boll weevil in the United States cotton fields, where liberal use of insecticides in 1924, together with more favourable climatic conditions, resulted in very little calcium arsenate being manufactured for this purpose in 1925 (*U.S. Dept. Comm. Circ.*: Arsenic in 1925).

Copper

Canada.—The Flin Flon property in northern Manitoba is to be developed on a large scale. A mill and smelter are to be built as well as a hydro-electric power station on the Churchill River. The branch line of the Canadian Pacific Railway, now terminating at Nipawin, Saskatchewan, is to be extended 131 miles eastwards to Flin Flon. A total expenditure of $24 million is said to be contemplated. (*Eng. Min. Journ.-Press*, 1925, **120**, Dec. 26, p. 1027.)

The refinery built by the British-American Nickel Company, Limited, at Deschenes, Quebec, has been purchased by the Consolidated Mining and Smelting Company of Canada. It is presumed that the plant will be adapted as a customs smelter for the copper-gold ores of the Rouyn district. (*Metal Bull.*, 1925, Dec. 11, p. 5.)

Gold

Gold Coast Colony.—Some promising results of prospecting, which were referred to in the annual report of Fanti Consolidated Mines, Ltd., dated February 10, 1926, have recently been obtained on the boundary between East and West Akim, Gold Coast Colony. The occurrence is a zone containing auriferous quartz which has been traced S.W. to N.E. for 30 miles, there being apparently very large sections of gold-bearing quartz. At Akokoaso, quartz lenses have been opened up to depths of 50 to 80 ft., by 11 shafts along a line for about 500 yd., the average value at the bottoms of the shafts being stated to be at least 2 oz. gold per ton, over a width of not less than 6 ft. At Kwae, 10 miles farther north, some auriferous quartz lenses 500 yds. north-east from some old native workings have been tested over a length of 1,000 ft. by means of trenches and in 3 shafts to a depth of 26 ft., and it is stated that the average value of the ore at the bottoms of the shafts is also well over 2 oz. gold per ton.

Canada.—According to the *Mining Journal* (1925, **155**, 886) and the *Canadian Mining Journal* (1925, **47**, 1062), the Red Lake area, in the western part of the Patricia district of north-west Ontario, was the scene of

important gold discoveries in the autumn of 1925. Red Lake is about 30 miles east of the Manitoba boundary, and about 180 miles north of the Canadian National Railway. The area has been known since D. B. Dowling inspected it in 1893. E. L. Bruce surveyed the locality in 1922 and the results of his examination with a map were published in the 33rd *Annual Report of the Ontario Bureau of Mines*, 1924, Part IV. The Howie-Red Lake Syndicate of Haileybury, Ontario, after two months' prospecting, found gold in September last in an ore channel of quartz and sericite-schist from 40 to 70 ft. wide, about 15 chains to the south of the lake. The rock formation in the vicinity of Red Lake consists of sedimentary rocks, greenstone, granite-porphyry and granite, and is stated to be similar to that of Porcupine.

The ore channel was traced for several hundred feet by stripping, and 60 channel samples yielded on an average $7 in value per ton. Richer ore was found in a parallel vein to the north.

Iron

United Kingdom.—The oolitic iron ore of Kent, which occurs in the Corallian Beds of the Jurassic System has been described in the publication, *Iron Ore, Part I* (1922) of the Imperial Mineral Resources Bureau (p. 71). First discovered at the base of Shakespeare Cliff, Dover, subsequent borings and shaft-sinking towards Folkestone showed that the deposits covered 20,000 acres and contained 100 million tons of ore. An analysis of the ore gave: iron, 32·20 per cent.; manganese, 0·129 per cent.; phosphorus, 0·401 per cent.; sulphur, 0·055 per cent.; and arsenic, 0·007 per cent. The loss on calcining was 19·40 per cent. and the specific gravity, 2·88.

In connection with the large-scale development of the Kent coal-field, referred to on page 123, A. E. Ritchie (*Iron and Coal Tr. Rev.*, 1926, **112**, Feb. 26, p. 380) points out that with a 30 per cent. iron content there are 30 million tons of iron in the ore. The Pearson and Dorman Long interests, which are about to develop a large portion of the Kent coal-field, will also develop and exploit the iron deposit, first from the Shakespeare pit. Blast furnaces will be built nearby, and foreign ores will be imported through Dover for blending purposes.

Lead

Australia. *Queensland.*—In *Chemical Engineering and Mining Review* (1925, **18**, Dec. 5, p. 102), particulars are given of four main haulage shafts that are being sunk by

Mount Isa Mines, Ltd., in various sections of the property. Three of these are vertical, while the fourth is on the incline. All are intended to go to a depth of about 300 ft. Boring is being conducted also to test the lode channels down to 1,000 feet. In the issue of the same paper for November 1925 it is reported that a bill has passed the Queensland Legislature for the construction of a railway to the field. The ore probabilities of the field have been estimated by the Government Geologist at 20 million tons. The two principal companies opening up this field have now combined, thus ensuring economical development.

Western Australia.—Developments on a galena lode at Braeside, in the north-west of the State, are promising, according to the *Industrial Australian and Mining Standard* (1925, **74**, Nov. 11, p. 649). A first shipment of 14 tons of ore has been made, containing 80 per cent. of lead and 9½ oz. of silver per ton.

Lithium

Canada.—Some further information on the recently discovered deposits of lithium minerals near Lamprey Falls, S.E. Manitoba, which has been referred to in this BULLETIN (1925, **23**, 498), is given in an article by J. F. Wright, of the Geological Survey of Canada. The only deposit which has been developed up to the present is about one mile south of Winnipeg River and 10 miles east of Pointe du Bois. There is an outcrop of massive lepidolite (lithia mica), but lately spodumene (lithium-aluminium silicate) and amblygonite (lithium-aluminium phosphate), with other rare minerals, have been discovered. It has been found that these lithium minerals occur in pockets and lenses in the central part of a body of pegmatite, which is exposed for 125 ft. in a general E. and W. direction, with an average width of 80 ft. It has been estimated that for every 10 ft. of depth of the area shown by these dimensions there are recoverable 2,500 to 3,000 tons of material containing 4¾ per cent. lithia (Li_2O). To the south of the pegmatite are two lenses of lepidolite in which for each 10 ft. of depth is about 540 tons of material containing nearly 4 per cent. lithia. As only 0·1 per cent. ferric oxide is present in this mica, it will probably be suitable for making opaline, white and flint glass. Amblygonite (9 per cent. Li_2O) and smaller amounts of spodumene (4 to 6 per cent. Li_2O) are the minerals from which are derived the lithium salts used chiefly in certain storage batteries, but also for medicine, photography, fireworks, etc., whilst lepidolite is used almost entirely in making special kinds of glass.

Manganese

Union of South Africa.—According to the *Mining Journal* (1926, **152**, Feb. 6, 110), a discovery of manganese ore was recently made in the Postmasburg district, of Barkly West, north-west of Kimberley. The deposit occurs in the Dolomite Series, exhibits a prominent outcrop along a series of hills running for many miles, and is considered to be one of the largest known.

So far, little work has been done in depth. A certain amount of ore with a very low iron content and with 81 per cent. manganese dioxide has been found which may prove suitable for chemical purposes, but the great bulk of the deposit contains ore of commercial grade.

It is considered that mining, sorting and loading can be carried on at small cost, and with a short railway connection to Winter's Rush, west of the Vaal River, the ore could be sent to Capetown, 700 miles away, for 15 shillings per ton, or to Luderitz, South-West Africa Territory, for 20 shillings.

Western Australia.—It is reported that a limited company has been floated in Perth to acquire from the General Chemical Supply Co., Ltd., the manganese ore deposits at Horseshoe, near Peak Hill, Western Australia, and to connect them by rail with Meekathara. The deposits are said to contain not less than 1¼ million tons of ore of good marketable quality, easily obtained by open excavation (*Chem. Eng. and Min. Rev.*, July 5, 1925, p. 402).

Nickel

Canada.—The first claims staked primarily for nickel values in British Columbia are described by C. E. Cairnes in the *Summary Report of the Geological Survey of Canada* (1924, Pt. A, pp. 100–105). They are in the basin of Emory Creek, in the Yale Mining Division, about 7 miles from Choate Station, on the Canadian Pacific Railway, which is 95 miles from Vancouver. The deposit is somewhat analogous, in both its mineral and geological features, to occurrences in Alaska, at Sudbury in Ontario and in other parts of the world. It forms the face of a reddish bluff, high up on the southern slope of the basin, consisting of nearly solid sulphide minerals, 30 ft. high and 75 ft. across. In order of abundance these minerals are pyrrhotite, pentlandite, chalcopyrite and magnetite. Pyrrhotite is by far the most abundant, the pentlandite being disseminated through it in minute grains difficult to distinguish in hand specimens. A sample over 45 ft.

of the deposit assayed a trace of gold, 3·6 dwt. silver per ton of 2,000 lb., 0·58 per cent. copper and 1·67 per cent. nickel. As, however, the surface of the deposit everywhere shows evidence of leaching and oxidation, the true values can only be determined by development in depth. The district is underlain chiefly by batholithic rocks having an average composition of quartz-diorite or basic granodiorite. These show some foliation, but their general structure is massive. They are in contact near the nickel deposit with a coarsely crystalline basic intrusive that has an average width of about 300 yds., and is probably a large dyke. This varies in composition from a rock composed almost entirely of sulphide minerals segregated with crystals of hypersthene, i.e. the nickeliferous deposit, to one in which hornblende is the chief constituent and sulphides are merely accessory.

Platinum and Allied Metals

Union of South Africa.—The result of milling and concentrating 367 tons of platinum ore in a pilot plant on the Onverwacht farm in the Lydenburg district of the Transvaal was the recovery as a concentrate of 156 oz. of platinum metals, which was sent to England for refining. The plant was running between January 13 and 31 for this output. The value of the tailing has not yet been published, so the percentage extraction cannot be calculated.

Australia.—The areas in Tasmania in which osmiridium has hitherto been won are almost all in the west, in a tract of country extending in a N.W. direction from Dundas to Heazlewood. In 1925, two fresh discoveries were made, one in the south of the island at New River and the other at Adams River, west of Fitzgerald, £93,000 worth of osmiridium having been recovered there by the end of the year. This latter occurrence is in an area about 10 miles long and two miles broad between Saw Back Range and Ragged Mountain Range. The locality is not easily reached, being twenty-eight miles west of Fitzgerald, the first twenty-two miles of which can be traversed by pack horses, but the last six miles is so swampy that men have to carry their supplies themselves. The Government Geologist, A. McIntosh Reid, has recently reported on the field, which is a broad glacier valley, along the broad bottom of which, since the Pleistocene glaciation, sediments of sandstones and consolidated gravels have been deposited. Below these are pale-green sandstones, presumed to be Permo-Carboniferous, which McIntosh Reid considers the most favourable matrix for osmiridium, the original source

of which is the serpentinised rocks bronzitite and peridotite. These in some cases are quite fresh and unaltered, whilst in others they are completely altered into serpentine. The pale-green sandstones appear to be the result of water action on the serpentine and on quartzites in the neighbourhood.

Tin

United Kingdom.—The revival of the Cornish tin mining industry is the subject of three interesting articles by D. Wylie King in the *Financial Times* (1926, Jan. 21, 25 and 27). It is stated that 24 mines, employing 2,500 men, are now in operation and that there is no apparent reason why the industry should not soon regain the prosperity of pre-war days. Substantial sums have been guaranteed under the Trades Facilities Act and money for requisite development is now being obtained more easily. In 1925, the East Pool and Agar mines produced 900 tons of tin concentrates; South Crofty produced 750 tons; and regular returns are being made by Geevor, Levant, Tresavean, Tincroft, Grenville Sands, Magdalene, Wheal Prosper and other mines. The current production of Cornwall is estimated to be at the rate of about 2,500 tons of refined tin per annum. The cost of fuel and materials has fallen and several mines would pay to work on a large scale even if the price of tin fell to £200 per ton.

In the Camborne-Redruth area four mines are regularly producing, viz.: East Pool and Agar, where nearly 500,000 tons of ore are practically in sight; South Crofty, where important developments are taking place north of the main road from Camborne to Redruth; Tincroft (Kingsdown Tin Mines); and Tresavean.

Nigeria.—A transitional stage is being reached in the Bauchi tinfields owing to approaching exhaustion of shallow rich deposits and the constant shortage of labour, accentuated by the large amount of railway construction. The railway from Port Harcourt will not reach Bukeru for two or three years, but when this is completed cheap coal and adequate labour should be available. Meantime an increasing amount of machinery is being installed for treatment of deeper ground. (*Mining Journal*, 1926, **152**, Jan. 9, p. 27.)

Burma.—*The Penang Gazette* is quoted by the *Malayan Tin and Rubber Journal* (1925, **14**, Oct. 31, pp. 1269–70) as calling attention to satisfactory developments in the tin-mining industry of the Mergui Archipelago. A com-

pany has been formed in Melbourne to prospect on Lampi Island, and other islands have been reported upon favourably. Among these are Pulo Balu or Sir Joseph Banks Island, Pulo Badak or Sir William James Island, and Eyles Island.

Preliminary tests at the Heinze Basin, about 60 miles north-west of Tavoy, indicate 15 million cubic yards of material averaging 31½ ft. in depth and not less than ¾ lb. per cubic yard. A dredge is to be set to work as soon as possible. (*Commerce* 1925, **31**, Sept. 26, p. 606.)

Federated Malay States.—A summary of the results obtained by suction-cutter dredges, about the performance of which there has been some controversy, is given in the *Mining Journal* (1926, **152**, Jan. 9, p. 27). It is stated that this type has not yet been able to compete with the bucket type, chiefly owing to a less quantity of material being treated per unit of power consumed. Many new bucket-dredges are on order for Malaya, of which at least 16 should be in commission in 1927. Opencast mining also shows increased activity, due to the saving in cost by substitution of oil-engines for steam and the rising price of tin. Consequently, ground has now become payable that could not be treated previously at a profit.

Australia.—The Stanhills tinfield, in the Croydon district of North Queensland, is reported on by E. C. Saint-Smith, Government Geologist, in *Queensland Government Mining Journal* (1925, **26**, Oct. 15, pp. 383–391). Work has recently been resumed in this tinfield, which extends along the Croydon–Esmeralda road from about 8 miles south-east of Croydon to within 12 miles of Esmeralda homestead, on the watersheds of the Norman and Gilbert rivers. The discovery of lode tin on the Carron River, about 22 miles north-east of Croydon, points to an area of about 1,000 square miles over which tin-lodes may be expected to occur more or less sparsely distributed. Some alluvial tinstone is also found in the valleys. The lodes occur in a coarse grey granite grading into aplite and capped by sandstone on the hilltops. Quartz-felsites also occur. A number of prospects are described, particularly the workings on the Mauretania lode, where most of the recent work has been done. A shaft at this point has shown the lode to be at least 7½ ft. wide at a depth of 92 ft. and to average 1·74 per cent. metallic tin. The Department of Mines has granted a loan under the Machinery Advances Act for the erection of a treatment plant. A five-stamp battery with concentrating tables, etc., is being erected.

Saint-Smith concludes that the geological conditions are distinctly favourable for the occurrence of payable ore-shoots. A fair amount of alluvial tin still remains to be won, but the future of the field depends upon the results obtained from lode-mining.

Rich amber tin-ore is reported to have been discovered in the Northern Territory, at a point 12 miles north-west of Tennant's Creek, which is 500 miles south of the Katherine River and 650 miles north of Oodnadatta (*Ind. Aus. and Min. Stan.*, 1925, **74**, Aug. 20, p. 240).

Vanadium

A new method of extracting vanadium has been devised by Rutger von Seth (*Eng. and Min. Journ.-Press*, 1925, **120**, p. 51). The iron ores of Sweden, high in phosphorus, contain a small percentage of vanadium in the form of oxide. When these or similar ores are smelted in the blast furnace, nearly the whole of the vanadium goes into the pig-iron.

In Seth's new process, the pig-iron containing, say, 0·2 per cent. of vanadium, is refined in an acid converter for 3 or 4 minutes until the vanadium passes into the slag. The metal is first poured, and the slag is collected afterwards, the pig-iron being refined in the ordinary way in a basic converter. The slag, which will contain at least 10 per cent. vanadic oxide, can then be reduced to vanadium or ferro-vanadium in a small electric furnace.

According to *Jarnkontorets Annaler*, Seth's new method of recovering vanadium from slag is about to be adopted by the Domnarvet and Bangro iron smelters. The process may be adopted for vanadiferous minettes or any products containing small percentages of vanadium. Incidentally, it should cheapen vanadium (*Queensland Govt. Min. Journ.*, June, 1925, **26**, p. 219).

NON-METALS

Asbestos

Canada.—*Canadian Official Mining Notes* (issued from the High Commissioner's Office, London, Jan. 15, 1926), referred to the occurrence of asbestos of good quality at the head waters of Quoicek Creek, near Lytton, B.C. The fibre is described as long, soft and strong, occurring in a vein of considerable width which has been traced for several miles.

Commenting on this report, the Resident Mining Engineer (B.C. Dept. of Mines) at Kamloops states (*Asbestos*, Jan. 1926, p. 38) that the occurrence has been

known for some years; that while the serpentine formation is known to extend for a considerable distance, he is not aware that the continuity of the asbestos has been proved; that the locality is inaccessible for the greater part of the year, being situated at an altitude of 6,000 ft.; and that there would need to be very definite assurance of the existence of a large deposit to compensate for the natural disadvantages of the locality.

China Clay

Canada.—A large deposit of clay, described as high-grade china clay, is the subject of an article by S. Hancock in *Can. Min. Journ.* (1925, **46**, Dec. 18 and 25, pp. 1149 and 1178). The deposit lies on the east bank of the Mattagami River in Kipling Township, Ontario, about 32 miles N.W. of the northern terminus of the Timiskaming and Northern Ontario Railway. Overlain by a covering of from one to four feet of dense fire-clay and yellow sand, the deposit is reported to consist of high-grade kaolin mixed with quartz sand and some fragments of felspar. It is suggested that the deposit was formed in place by the kaolinisation of a quartz-felspar pegmatite, and that it was protected from erosion during the glacial period by its situation in a vast amphitheatre of rock, or alternatively, that the alteration has taken place in post-glacial times.

Analysis of the clay washed from the sandy material gave in percentages in one case: silica, 49·40; alumina, 35·79; iron oxides, 0·13; loss, 13·85. In another case analysis gave silica, 51·80; alumina, 35·20; iron oxides, 0·21; loss, 12·80. An immense amount of this clay is stated to be available, and the silica washed from it is also likely to be of considerable value (*see* p. 130). The Government of Ontario is stated to be assisting in the development of these deposits.

Coal

United Kingdom.—The Kent coal-field has been described in the Imperial Institute monograph *Coal* (p. 24). Strahan estimates its area at 206 sq. miles, of which 56 miles is under the sea and accessible. Mainly because of insufficient financial support, results of mining have so far been disappointing, but now an important development scheme for about 60 sq. miles of the field has been put forward by Messrs. Pearson & Son, Ltd., and Messrs. Dorman, Long & Co., Ltd., which will require an initial capital of about £7,000,000. Of this H.M. Treasury under the Trade Facilities Act has agreed to lend £2,000,000 for 30 years. The area to be developed,

roughly triangular in shape, is east of a line joining Canterbury to Dover. There are a number of boreholes in the area as well as the Snowdown, Tilmanstone, Guilford and Betteshanger collieries. In the first a 4 ft. 5 in. seam is being developed at 3,000 ft. depth. The second is producing about 4,500 tons of coal per week, while in the last, which is being developed on very modern lines, it is expected that coal will be reached by the end of 1926.

It is expected that 20,000 miners will ultimately be wanted in East Kent, and that as a result of various industries likely to be developed, including the production of iron (*see* p. 116), the population will increase in 30 years from 300,000 to 600,000, and that 60,000 extra houses will be required. The sinking of 18 or 20 pits has been considered, and it has been estimated that the extraction of all the coal would take from 300 to 400 years (*Iron and Coal Tr. Rev.*, 1926, **112**, Feb. 26, p. 380).

Canada.—The coal area of the Hat Creek district, in the Clinton Mining Division of British Columbia, was favourably described by G. M. Dawson of the Geological Survey of Canada in 1878, but nothing was done to open up the deposit till recently. The Clear Mountain Coal Co., Ltd., of Vancouver, commenced to prospect the deposit in 1923, but no drilling was commenced until the middle of 1925, according to the *Times Trade and Engineering Supplement* (Aug. 15, 1925, p. 541). At the surface, the coal appeared to be lignitic, but drilling showed that it was really bituminous. An analysis gave in percentages: moisture, 8·52; volatile matter, 43·30; fixed carbon, 44·18; ash, 4·00 and sulphur, 0·44. The calorific value was 12,240 B.T.U. The new field is 15 miles east of the Pacific Great Eastern Railway and within 150 miles of Vancouver.

Australia.—According to the Melbourne *Age* (Oct. 28 and Dec. 2, 1925) a discovery of coal has been made in Victoria at South Ecklin, 11 miles from Terang, which has been tested to a depth of 40 ft. from the surface. The coal is stated to be harder and darker than Victorian brown coal. As a result of analysis some samples submitted to the Mines Department gave a ratio of fixed carbon to volatile matter of 1 to 1·95 and 87·80 per cent. of combustible matter, and indicated a high-grade lignite: the results of other sampling indicated a low-grade lignite or peat. Several bores have been put down to depths of 35 to 45 ft.

Fluorspar

Australia.—*Queensland.* According to the *Annual Report of the Under Secretary for Mines*, the output of fluorspar

in Queensland in 1924 was 1,864 tons, valued at £5,240, as against nil in the previous year. Provisional figures for the first nine months of 1925 record a production of 4,247 tons. All the mines are in the Chillagoe district, the chief producer being the Perseverance mine. This was described by E. C. Saint-Smith in *Queensland Government Mining Journal* (1923, **24**, Nov. 15, pp. 418–19). The lode, which has been traced over a total length of 17 chains, occurs near Almaden, about 10 miles S.S.E. of Chillagoe. The country rock is a medium-grained granite, mostly quite unaltered. The fluorspar occurs in lenses along a practically straight line of fissuring and the width varies up to 5½ ft. An average sample of 15 tons of clean mineral raised from one of the shafts contained 97·30 per cent. of CaF_2 and 1·11 per cent. of $CaCO_3$. Saint-Smith estimated that 9,000 tons of high-grade mineral were available above water level, that mining costs would be about 10*s*. per ton, and that total costs per ton bagged and delivered at the wharf at Cairns would be 43*s*. per ton.

Graphite

Ceylon.—The Ceylon Plumbago Merchants' Union report a considerable improvement in exports and prices of Ceylon graphite. According to a summary of their report in the *Ceylon Observer* (1925, Sept. 22, p. 4), exports during the first six months of 1925 amounted to 7,462 tons, valued at Rs.1,227,552. This is an increase over the corresponding period of 1924 of 2,456 tons and Rs.550,517. Germany took 2,900 tons in the first half of 1925, and is expected to be the most important buyer of Ceylon graphite. The prices obtainable for the better grades are stated to be still unsatisfactory. In July, 1925, 103 mines were at work with 2,815 men, as compared with 30 mines and 1,362 men in July, 1924. It is pointed out that the tests made by the U.S. Bureau of Mines were conducted solely for the purpose of furthering the interests of American producers, and that the results of these purely laboratory experiments, claiming that other graphites were superior to the Ceylon product for crucibles, were regarded as somewhat amusing by the trade. The crucibles actually made fell far below the requirements of the trade, the highest average number of heats obtained being 7·67 for steel melting and 13·1 for brass melting, whereas the trade requires something like 60 or more heats per crucible, depending upon the material to be melted. In order to assist the graphite industry the Ceylon Government has abolished the export tax on graphite as well as the import tax on explosives.

Gypsum

Canada.—The Thirty-fourth Annual Report of the *Ontario Dept. of Mines* (1925, **34**, Pt. 2) contains two papers on gypsum. One of these, by G. E. Cole, on "Gypsum in Ontario," is largely a compilation. It deals with the subject in three sections: (1) general information on gypsum, its properties and the history of the industry in Ontario; (2) the geology of the Ontario gypsum occurrences, and (3) descriptions of the mines and mills at Caledonia and Lythmore, with notes on the technology of gypsum. Both massive and fibrous forms of gypsum occur in the province, but only the former is mined. Alabaster does not occur in Ontario. Anhydrite has been encountered in deep holes drilled for salt near Goderich, Huron County. Gypsum has been worked in Ontario since 1822 and is to-day one of the most important non-metallic minerals mined in the province. It occurs extensively in the coastal plain south of James Bay, northern Ontario, and in the Grand River basin, southern Ontario; also sparingly elsewhere, but the distance from transportation of the former deposits renders those of southern Ontario the more important economically. Up to the present, the mines of Caledonia and Lythmore have supplied all the requirements of a market covering the whole of the province of Ontario and the greater part of the province of Quebec.

The second paper, by W. S. Dyer, is concerned with the "Geology of the Gypsum deposits of South-Western Ontario." The principles of salt and gypsum deposition are discussed at length. The author considers that both salt and gypsum were formed in Ontario in desert basins with inward drainage; that the gypsum was not derived by secondary alteration from limestone, but that it represents the connate salt remaining in the rocks after the more soluble sodium chlorides had been leached out for redeposition in the central basin. The calcium sulphate in this region is divided vertically into three zones, a gypsum zone down to 225 ft., a mixed zone of gypsum and anhydrite from 225 to 275 ft., and an anhydrite zone below that. The greater part of the calcium sulphate was originally deposited as anhydrite, which has been subsequently changed to gypsum by circulating meteoric waters.

Phosphates

India.—According to *Chemical Age* (1926, **14**, Jan. 30, p. 93) it has been shown that where cheap electrical

energy is available it would be possible to produce a valuable phosphatic manure from Indian apatite.

By the electrolysis of a solution of sodium perchlorate, perchloric acid and caustic soda are produced. The acid will dissolve apatite, and the addition of a suitable amount of caustic soda to the solution causes the precipitation of dicalcic phosphate, which is wholly citrate-soluble and, therefore, a valuable fertiliser. Sodium perchlorate is regenerated by this method and can be electrolysed over again. The experimental conditions under which a high current-efficiency is attained have been worked out.

Petroleum and Allied Products

United Kingdom.—The unprofitable condition reached in the Scottish shale industry, and the proposal to reduce wages in consequence, led the Board of Trade to appoint a firm of accountants to investigate costs of production and financial results of Scottish Oils Ltd. Nearly four million sterling is involved in this undertaking, which operates the principal shale mines in the Lothians as well as distillation and refinery works in connection with them. The accountants deal principally with the period of six months ending September 30, 1925 (Cmd. 2538, 1925), and treat twelve shale-mines separately in detail. The total production during this period was 1,446,800 tons of oil-shale. The average cost of mining was 7*s.* 3·0*d.* per ton. Adding 3*s.* 5·2*d.* for retorting and 1*s.* 7·1*d.* for sulphate of ammonia plant, the total average cost per ton of oil-shale was 12*s.* 3·3*d.* per ton. After crediting the value of ammonium sulphate produced the net cost per ton of shale is 8*s.* 7·8*d.* This is equivalent to a cost of 5·17*d.* per gallon of crude shale-oil and crude naphtha produced, comparing with an average actual value of 3·68*d.*, thus resulting in a loss of 1·48*d.* per gallon. All the mines showed a loss during the period, but considerable variation is exhibited by different mines.

Union of South Africa.—The prospects of an oil-shale industry in the Union are dealt with in a preliminary report to the Minister of Mines and Industries by a special committee, printed in *South African Journal of Industries* (1925, May). Following the report by Major Trevor, published in the *Journal of Industries* for July, 1925, the committee state " it seems probable, however, that large quantities of oil shale of a workable thickness and with a yield of crude oil exceeding 20 gallons per ton exist in the districts of Wakkerstroom, Utrecht and Newcastle." A seam of torbanite about 12 in. thick occurs in the

Ermelo district associated with coal, but insufficient work has been done on it to permit estimates of tonnage to be formed. The Wakkerstroom shales yield a crude oil containing about the following percentages : motor spirit 10, kerosene 20, fuel oil 25, lubricating oil 25, and tar or pitch 20, in addition to some paraffin wax.

Although the Committee consider the estimates put before them to be somewhat optimistic, they are of the opinion that there is a possibility of establishing a profitable industry, especially if Government assistance is given. The chief danger foreseen is that of unfair competition. The final portion of the report is not yet published. It deals with the recommendations of the Committee in regard to possible methods of assistance to the industry by Government.

Canada.—S. C. Ells recently addressed the Calgary Branch of the Engineering Institute with reference to the " tar-sands " of Alberta. Attention was drawn to the fact that in the United States tar from sands containing less bitumen is used in large quantities for road-making, despite the long distances over which it has to be carried and in face of competition from tar produced by other methods. At present imported asphalt costs $11 per ton in Winnipeg, but Ells contends that Alberta bitumen could be sold there at $8 and would be able to meet all competition from oil-refineries (*Can. Chem. and Met.*, 1926, **10**, Jan., p. 2).

India.—The development of the Punjab oilfields was somewhat disappointing in 1924, there being no large production from individual new wells such as occurred in 1923. Oil has been proved at widely distant locations on the Khaur field and the information obtained has enabled the technical staff of the Attock Oil Co. to recommend drilling through the shallower horizons by rotary drill, in order to reach the deeper productive sands more rapidly. The refinery gave satisfactory results, but its capacity was in excess of production from the wells. Prospects of obtaining oil in the Dhulian field are considered to be promising and a well had been drilled to 3,286 ft., where water under heavy pressure was encountered. Work was temporarily suspended as the rotary drill was required on the Khaur field (*Commerce*, 1925, **31**, Aug. 22, p. 353).

Australia.—Arthur Wade, in his " Report on Petroleum Investigations made in New South Wales " (*Common-*

wealth of Australia Report, 1925), concludes that the Permo-Carboniferous System of the Sydney Basin constitutes the best field for exploration in the State, the most likely area being the Hunter River district on the northern and north-western margins of the basin; but suggests that, at the same time, prospecting for suitable structures should be carried out in the north-west corner of the basin. The Belford Dome should be tested for natural gas by drilling to at least 3,000 ft., and the boring should prove a workable extension of the Greta coal measures, which supply the best export coals in Australia. West and north-west of Belford, areas exist in which the carbon ratios in the Upper Coal Measures are apparently more or less consistently below 60—these areas should be prospected for suitable structures that might be tested for supplies of natural gas; moreover there is some slight hope of the occurrence of small pools of oil in such structures if conditions should prove favourable.

Wade also reports on the possibility of oil discovery in Queensland (*Commonwealth of Australia Report*, 1925). Actual oil has been proved to exist at depths in the Walloon strata along the edges of the Great Artesian Basin of Central Queensland. Evidence indicates that there is some prospect of oil being found at moderate depth, where structural features are favourable.

A further report on oil by Wade deals with "Petroleum Prospects in Parts of Western Victoria, South Australia and Western Australia" (*Commonwealth of Australia Report*). The only area visited that he considers worthy of further attention is near the Glenelg River, in Victoria, near the South Australian border. Tertiary deposits here are thick and may contain beds from which oil may have originated, suitable storage beds and cover rocks, but structurally it is not proven. Detailed geological and palæontological work is recommended, but no drilling is advised unless this work reveals the presence of suitable structural conditions.

Salt

Palestine.—Salt is now being produced on a commercial scale in Palestine, by evaporation of sea water in artificial basins covering 600,000 sq. metres. In *Colonial Reports: Palestine and Transjordania* (1924, Colonial No. 12) it is stated that these works are at Athlit, on the coast. In consequence of a reduction in price and the establishment of salt-stores in the principal towns, sales have been doubled.

Silica

Canada.—In an article by the Director of the Canadian Geological Survey, in *Can. Min. Journ.* (1926, **47**, Jan. 15 and 22, pp. 54 and 82) on the ore deposits of the district north of Lake Huron, Ontario, it is stated that the topmost part of the Lorraine quartzite is sufficiently pure to be used as an acid flux in nickel-copper smelting at Sudbury. It would probably also make silica bricks. The quartzite is also quarried on Badgeley Peninsula for the manufacture of ferro-silicon at Welland, Ontario. The middle part of the Lorraine quartzite is conglomeratic and furnishes in the Bruce Mines area an ornamental stone of unusual appearance due to the occurrence of dark grey and bright red (jasper) pebbles in it.

In an article on Ontario quartzites available for the manufacture of silica brick, E. S. Moore and G. B. Langford (*Can. Min. Journ.*, 1925, **46**, Dec. 4, p. 1110) state that the Lorraine quartzite is quarried also at Bellevue, near Sault Ste. Marie, for silica bricks used in the steel plant at Steelton, Ontario. The authors compare this rock favourably with the Tuscarora quartzite of Pennsylvania, United States, one of the best rocks known for silica brick manufacture.

The article deals fully with the chemical composition of the quartzite from different localities, and gives the results of microscopic examinations and fusion tests on several samples.

The authors point out that with so large a supply of suitable material situated on the north shore of Lake Huron, Ontario should be in a position to supply her own demands and part of those of adjacent provinces for this important refractory material.

The occurrence in Kipling township, Ontario, of a deposit of china clay containing silica sand is described on p. 123. The silica washed from this clay is said to be very pure, having a silica content of over 99 per cent., and being practically free from iron. The possibility of using it in glass-making has been suggested.

Uranium (Radium) Minerals

Australia.—Substantial progress is being made in the development of the South Australian deposits of radium minerals. According to the *Chem. Trade Journ.* (1926, **78**, Feb. 5, p. 152), the three mining companies at work on the deposits will eventually merge with the company which concentrates the material and recovers the radium. Production on a large scale is anticipated. A new treatment

plant, which has been installed at Dry Creek, near Adelaide, is stated to be capable of treating 400 tons of concentrate per month. Large scale trials have shown that from 1 ton of concentrates 11 milligrams of radium can be recovered, which indicates a possible production of about 4 grams of radium per month.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, December 1925–February 1926.

General

List of Mines in Great Britain and the Isle of Man. By H.M. Inspectors of Mines. *Mines Dept.* Pp. vi + 422, 9½ × 6. (London: H.M. Stationery Office, 1925.) Price 18*s.* 6*d.* net.

The Geology of the Country around Stoke-upon-Trent. By W. Gibson. With contributions by C. B. Wedd and A. Scott. *Mem. Geol. Surv. England, Explanation of Sheet* 123. Pp. 112 + xv, 9½ × 6. (London: H.M. Stationery Office, 1925.) Price 2*s.* 6*d.* net.

Annual Report on the Geological Survey, Government of the Gold Coast, for the period April 1923 to March 1924. Pp. 57. (London: Crown Agents for the Colonies.) Price 3*s.*

Tanganyika Territory: Annual Report of the Department of Lands, Survey, and Mines, for the year 1923. Pp. 25. (Dar-es-Salaam: Government Printer.)

Mineral Resources of the Lardeau and Trout Lake Mining Divisions of British Columbia. By N. W. Emmens. *Can. Min. Journ.* (1926 **47**, 5–8, 36–38).

Mineral Resources of Manitoba. By R. C. Wallace. *Can. Min. Journ.* (1925, **46**, 1171–1177)

Geology and Mineral Deposits of the East Central Manitoba Mining District. By J. F. Wright. *Bull. Can. Inst. Min. and Met.* (1925, No. 164, pp. 1146–1164).

Mineral Deposits of Hudson Bay Territory. By R. C. Wallace. *Bull. Can. Inst. Min. and Met.* (1925, No. 164, pp. 1165–1176).

The Mineral Production of India during 1924. By L. L. Fermor. *Rec. Geol. Surv. India* (1925, **58**, 241–322).

Report of the Chief Inspector of Mines in India under the Indian Mines Act for the year ending December 31, 1924. Pp. vi + 146, 9¾ × 6½. (Calcutta: Government of India Central Publication Branch, 1925.) Price Rs.2 As.8 (4*s.* 6*d.*).

The Geology and Ore-Deposits of Mt. Stewart, Leadville, N.S.W. By T. L. Willan. *Proc. Austr. Inst. Min. and Met., N.S.* (1925, No. 57, pp. 1–26).

Annual Report of the Under-Secretary for Mines, Queensland; including the Reports of the Wardens, Inspectors of Mines, Government Geologists, and other Officers for the year 1924. Pp. 145, 13 × 8½. (Brisbane: Government Printer, 1925.)

Annual Report of the Director of Mines and Government Geologist, South Australia, for 1924. Pp. 8, 13 × 8½. (Adelaide: Government Printer, 1925.)

Report of the Secretary for Mines, Tasmania, for year ending

December 31, 1924. Pp. 33, 13 × 8½. (Hobart: Government Printer, 1925.)

Mining in New Zealand (Extract from Official Yearbook, 1926). Pp. 20, 9½ × 6½. (Wellington: Government Printer.)

Annales des Mines de Belgique (1925, **26**, No. 3, pp. 857–1157). *Ministère de l'Industrie, du Travail et de la Prévoyance Sociale.* (Brussels: 1925.)

Die Zielrichtung des deutschen Berg- und Hüttenwesens in der Weltwirtschaft. By E. Haber. *Glückauf* (1926, **62**, 143–146).

L'Activité de l'Industrie chimique en Pologne, au cours de l'année 1924. By T. Zamoyski. *Chim. et Ind.* (1926, **15**, 153–156).

Estadística Minera de España, 1924. *Dir. Gen. de Minas e Indust. Metal.* Pp. 832, 10½ × 7½. (Madrid: Vicente Rico, 1925.)

The Industrial Life of Sweden. Ore deposits and metal industries. By Westin-Silverstolpe. *Journ. Swedish Ch. Commerce* (1926, **18**, 8–10).

Bergshantering Berättelse för år 1924 av Kommerskollegium. *Sveriges Officiella Statistik. Industri och Bergshantering.* Pp. 83, 9½ × 6½. (Stockholm: Bureau Central de Statistique de Suède, 1925.)

Annual Report of the Director of the Bureau of Mines for the Fiscal Year ended June 30, 1925. *U.S. Dept. Interior.* (Washington: Government Printing Office, 1925.)

Mineral Resources of Alaska. Report on Progress of Investigations in 1923. By A. H. Brooks and others. *Bull.* 773, *U.S. Geol. Surv.* Pp. iii + 267, 9 × 6. (Washington: Government Printing Office, 1925.) Price 40 cents.

Mineral Resources of the United States in 1924. Magnesium and its Compounds; Phosphate Rock; Salt, Bromine, and Calcium Chloride; Slate; Silver, Copper, Lead, and Zinc in the Central States. (Mine Rept.) *U.S. Geol. Surv.* (Washington: Government Printing Office, 1925.)

Mines and Minerals of Inyo County, California. By G. J. Young. *Eng. and Min. Journ.-Press* (1925, **120**, 969–972).

Ore Deposits of the Saddle Mountain and Banner Mining Districts, Arizona. By C. P. Ross. *Bull.* 771, *U.S. Geol. Surv.* Pp. vii + 72, 9 × 6. (Washington: Government Printing Office, 1925.) Price 25 cents.

Eindrücke einer bergmännischen Studienreise in den Vereinigten Staaten von Nordamerika. By W. Funcke. *Glückauf* (1926, **62**, 37–45, 76–81, 107–111).

The Mineral Resources of the Philippine Islands for the years 1921, 1922, and 1923. Pp. 63, 10½ × 7½. (Manila: Bureau of Printing, 1925).

The Mineral Resources of Maranhão, Brazil. By E. W. Shaw, W. H. Wright, and J. L. Darnell, Junr. *Econ. Geol.* (1925, **20**, 723–729).

Die Entwicklung von Niederländisch-Ost-Indien als Bergbauland. By L. Rutten. *Internationale Bergwirtschaft* (1925–26, **1**, 5–9, and 78–83).

Les Richesses Minières de la Nouvelle Calédonie. *Bull. de l'Ag. Gen. des Col.* (1925, **18**, 1021–1026).

Genesis of Ore-Bodies. By J. D. Kendall. *Mining Mag.* (1926, **34**, 9–21).

Classifying Mining Ventures. By G. A. Packard. *Eng. and Min. Journ.-Press* (1926, **121**, 207–208).

Problems in Paint and Varnish Technology. The Need for Experimental Investigation. By H. Houlston Morgan. *Journ. Roy. Soc. Arts* (1926, **74**, 271–291).

A New Instrument for Surveying Boreholes. By J. S. Owens. *Bull. Inst. Min. Met.* (1926, No. 256, 18 pp.).

Tunnelling in Connection with a Hydro-Electric Project. By R. J. D. Richardson. *Bull. Inst. Min. Met.* (1926, No. 256, 21 pp.).

Instruments and Methods for the Discovery of Useful Mineral Deposits. By C. A. Heiland. *Eng. and Min. Journ.-Press* (1926, **121**, 47–58 with bibliography).

The Smalzi Method and Apparatus for Electrical Prospecting. By W. H. Fordham. *Mining Mag.* (1926, **34**, 25–28).

Swedish Electric Prospecting Methods. By H. Lundberg, K. Sundberg, and J. E. Klund. (Extracts from report of *Geol. Surv., Sweden.*) *Can. Min. Journ.* (1926, **47**, 29–32, 51–52, 75–79, 99–103).

Geophysical Methods as a Help to the Mining Engineer. By W. H. Fordham. *Min. Journ.* (1925, **151**, 908–909; 931–932; 955–956).

Electrical Conductivity of Ore-Minerals. By P. F. Kerr and C. K. Cabeen. *Econ. Geol.* (1925, **20**, 729–737).

Metals

Aluminium and Bauxite

The Bauxite Deposits of the Gold Coast. By A. E. Kitson. *Mining Mag.* (1925, **33**, 265–270).

Bauxite Production in Jugoslavia. By T. L. Milic. *Min. Journ.* (1926, **152**, 178).

Discovery of a large Bauxite Deposit in Montenegro. *Min. Journ.* (1925, **151**, 957).

The Aluminium Company of America. *Min. Journ.* (1925, **151**, 831).

The Aluminium Trust of America. *Min. Journ.* (1926, **152**, 176).

Haglund Process for the Electrothermic Production of Pure Aluminium Oxide. By P. R. Haglund. *Indust. and Eng. Chem.* (1926, **18**, 67–68).

The Outlook for Bauxite for 1926. By R. J. Anderson. *Min. Journ.* (1926, **152**, 28–29, 47–48).

Copper

Ancient Copper Mining and Smelting in Central Africa. By G. L. Walker. *Eng. and Min. Journ.-Press* (1925, **130**, 811–816).

Gold and Copper Deposits near Payson, Arizona. By C. Lausen and E. D. Wilson. *Bull. No.* 120, *Geol. Ser. No.* 4, *Arizona Bur. Mines.* Pp. 44, 9 × 6. (Tucson, Arizona: State University, 1925).

Reconstruction and Improvements at Mason Valley, Nevada. By G. J. Young. *Eng. and Min. Journ.-Press* (1926, **121**, 44–46).

The Copper Deposits near Salmon, Idaho. By C. P. Ross. *Bull.* 774, *U.S. Geol. Surv.* Pp. iv + 44, 9 × 6. (Washington: Government Printing Office, 1925.) Price 15 cents.

New Reverberatory Smelting Plant of the United States Metals Refining Co. By F. R. Corwin. *Eng. and Min. Journ.-Press* (1926, **121**, 197–205).

Gold

Note on the Geology of the Felixburg Goldfield. By A. M. Macgregor. *Short Rep. No.* 18, *S. Rhod. Geol. Surv.* Pp. 6, 9½ × 6, 1925.

Les gisements aurifères découverts en Sibérie orientale. *Bull. Écon. Indochine, N.S.* (1925, **28**, 363–365). (Extract from *Bulletin quotidien de la Société d'Études et d'informations économiques,* No. 104, May 8, 1925.)

Gold Dredging in Chile. By J. H. Ivey. *Mining Mag.* (1925, **33**, 338).

Iron and Steel

Certain Unsolved Problems relating to Manganese Steel. By R. A. Hadfield (Address to Fifth Congress of Industrial Chemistry—Paris). *Journ. Soc. Chem. Ind.* (1925, **44**, 1042–1044).

The Kent Coalfield. By A. E. Ritchie. *Iron and Coal Tr. Rev.* (1926, **112**, 380).

North Shore of Lake Huron. By W. H. Collins. *Dept. Mines, Canada, Geol. Surv. Mem.* (1925, No. 143).

Australia—the Infant in the Iron Industry. By O. R. Kuhn. *Eng. and Min. Journ.-Press* (1925, **120**, 931–938).

Die Weltgewinnung an Eisen und Stahl. By J. W. Reichert. *Stahl u. Eisen* (1926, **46**, 65–73).

Minas del Rif and Moroccan Iron. By C. de Kalb. *Min. and Met.* (1925, **6**, 563–565).

Ergebnisse der zahlenmässigen Erfassung des Arbeitsvorganges auf den Gruben der Gewerkschaft Eisenzecherzug. By K. Bergheim and A. Tamm. *Glückauf* (1926, **62**, 133–140, 167–173).

Die Eisenversorgung Deutschlands in der Nach-Kriegszeit. *Wirts. u. Stat.* (1926, **6**, 34–36).

Der heutige Stand der basischen Herdfrischverfahren im Vergleich zum Thomasverfahren. By F. Bernhardt. *Stahl u. Eisen* (1926, **46**, 1–7, 39–44, 73–78, 137–142).

Verringerung und Verhalten des im Generatorgas enthaltenen Schwefels im Siemens-Martin-Ofen. By J. Bronn. *Stahl u. Eisen* (1926, **46**, 78–80).

Geschichte und Entfaltung der tschechoslowakischen Eisenindustrie. By R. Doderer. *Prager Tagblatt Jubilee No. Montan. Runds* (1926, **18**, 44–47).

Informe sobre la Existencia de Mineral de Hierro en los alrededores mayores de Potrerillos y Cacheuta en la Provincia de Mendoza. By R. Beder, *Publ. No.* 6, *Dirección General de Minas, Geologia e Hidrologia* (*Sección: Geologia*), *Argentina*. Pp. 17, 10½ × 7. (Buenos Aires, 1925.) Price 1 peso.

Lead

The Lead Industry. I. North America, South America, and Oceania. By R. M. Sandmyers, with a Report on United States Production and Trade by C. E. Siebenthal. *Tr. Inform. Bull., No.* 368, *U.S. Bur. For. and Dom. Comm.* Pp. 47, 9 × 6. (Washington: Government Printing Office, 1925.)

Manganese

Manganiferous Ores in the Cuyuna District [Minnesota]. By C. Zapffe. *Min. and Met.* (1925, **6**, 573–574).

Molybdenum

Molybdenum. Metallurgy and Uses, and the Occurrence, Mining, and Concentration of its Ores. By V. L. Eardley-Wilmot. *Publ. No.* 592, *Mines Br., Dept. Mines, Canada.* Pp. 292, 9¾ × 6½. (Ottawa: Government Printer, 1925.)

Platinum

The Platinum Deposits of the Bushveld Igneous Complex. [Abstract of a paper by P. A. Wagner read before the Geological Society of South Africa.] *S. Afr. Min. and Eng. Journ.* (1925, **36**, 315–316).

Quicksilver

The Metallurgy of Quicksilver. By L. H. Duschak and C. N. Schuette. *Bull.* 222, *U.S. Bur. Mines.* Pp. 173, 9 × 6. (Washington: Government Printing Office, 1925.) Price 30 cents.

Tin

Revival of the Cornish Tin Mining Industry. By D. W. King. *Financial Times* (1926, January 21, 25, 27, 29, February 1 and 2).

New Tin Areas in the East. *Malayan Tin and Rubber Journ.* (1925, **14**, 1269–1270).

Stanhills Tinfield, Croydon District, North Queensland. By E. C. Saint-Smith. (Geol. Surv. Rep.). *Queensland Govt. Min. Journ.* (1925, **26**, 383–391).

Some Bolivian Tin Mines. By J. H. Ivey. *Mining Mag.* (1925, **33**, 220–223).

The Mineral Resources of Andean Bolivia. By R. Pilz. *Min. Journ.* (1925, **151**, 769–771; 789–790; 821–822; 830–831) [Extracted from *Metall u. Erz*].

Banka Tin in 1924/1925. *Comm. Holland* (1925, **5**, No. 62, pp. 25–28).

Zinc

Vieille-Montagne—a Pioneer in the Zinc Industry. By G. Saint-Paul de Sinçay. *Eng. and Min. Journ.-Press* (1926, **121**, 4–7).

Étude sur les huiles de flottation appliquées aux blendes d'Ingurtosu. By P. Audibert. *Rev. de l'Ind. Minérale* (1926, No. 122, Part I, pp. 21–40).

NON-METALS

Asbestos

Asbestos Deposits of Arizona. By J. Melhase. *Eng. and Min. Journ.-Press* (1925, **120**, 805–810).

Barium Minerals

Schwerspatbergbau und Schwerspatwirtschaft. By E. Redeker. *Gluckauf* (1925, **61**, 1358–1365).

Cement

La fabrication de la chaux et la possibilité de produire des ciments à Madagascar. By M. Duclos. *Bull. Écon. Madagascar* (1925, pp. 65–72, with 8 maps).

China Clay

China Clay and Silica Sand in Kipling Township, Ontario. By S. Hancock, Jr. *Can. Min. Journ.* (1925, **46**, 1149–1151; 1178–1179).

Coal

The Kent Coalfield. By A. E. Ritchie. *Iron and Coal Tr. Rev.* (1926, **112**, 300 and 380).

Physical and Chemical Survey of the National Coal Resources No. 5. The Lancashire Coalfield—the Smith Seam. *Fuel Res. Bd., Dept. Sci. Indust. Res.* Pp. 32, 9½ × 6. (London: H.M. Stationery Office, 1925.) Price 1*s.* 6*d.*

Evidence for an Easterly Extension of the Warwickshire Coalfield. By W. S. Boulton. *Trans. Inst. Min. Eng.* (1925, **70**, 69–78).

The Coal Measures of the Eastern Transvaal. III and IV. *S. Afr. Min. and Eng. Journ.* (1925, **36**, 264 and 367–368).

Coal Statistics for Canada for the Calendar Year 1924. *Dom. Bur. Stat., Min., Metall., and Chem. Br.* Pp. 96, 9¾ × 6½. (Ottawa: Government Printer, 1925.) Price 25 cents.

Analyses of Alberta Coal. By E. Stansfield, R. T. Hollies, and W. P. Campbell. *Rep. No.* 14, *Sci. and Indust. Res. Counc., Alberta.* Pp. 63, 10 × 6½. (Edmonton: King's Printer, 1925.) Price 25 cents.

The Permo-Carboniferous Coal Measures, etc., of the Nebo District. By J. H. Reid. *Queensland Govt. Min. Journ.* (1925, **26**, December 15, pp. 465–474).

Die Kohlenvorkommen Albaniens. By E. Nowack. *Montan. Runds.* (1926, **18**, 69–84.)

Ausbeutung und wirtschaftliche Bedeutung der Kohlenvorkommen Spitzbergens. By C. Klees. *Glückauf* (1925, **61**, 1251–1257).

Fünfzig Jahre tschechoslowakischer Steinkohlenbergbau. By E. Fanta. *Prager Tagblatt Jubilee No. Montan. Runds.* (1926, **18**, 38–42).

Entfaltung der tschechoslowakischen Braunkohlenreviere. By H. Löcker. *Prager Tagblatt Jubilee No. Montan. Runds.* (1926, **18**, 42–44).

Report of the United States Coal Commission. In 5 parts. Pp. xx + 2719, 9 × 6 (pts. 1 to 4); and v + 516, 9 × 13½ (pt. 5, statistical tables). (Washington: Government Printing Office, 1925.)

The Rheolaveur Process of Washing Coal. By A. Andry and G. B. Robinson. *Colliery Guardian* (1925, **130**, 1459–1460; 1521–1522; 1926, **131**, 37–38; 85–86).

Coal-cutting by Machinery and Conveyors in Scottish Mines. By G. L. Kerr. *Trans. Inst. Min. Eng.* (1926, **70**, 206–214).

The New Coal-treatment Laboratory at Birmingham University. By K. Neville Moss. *Trans. Inst. Min. Eng.* (1926, **70**, 178–195).

Investigation on the Briquetting of New Zealand Coals (extract from 58th Ann. Rept. *Dom. Lab.*). Pp. 17. (Wellington: Government Printer.)

Coal Ash and Clean Coal. By R. Lessing. *Journ. Roy. Soc. Arts* (1926, **74**, 182–197; 205–218; 224–241).

Die Aussichten der Ölerzeugung aus Kohle. By F. Bergius. *Internationale Bergwirtschaft* (1925/26, **1**, 1–5).

Die Benzolgewinnung aus dem Steinkohlengas. By A. Schmalenbach. *Glückauf* (1926, **62**, 45–50).

Diatomaceous Earth

Diatomaceous Earth (with special reference to Nevada). By C. W. Davis. *Repts. of Investigations, U.S. Bur. Mines* (1925, Ser. No. 2718.) Pp. 14. Mimeographed. (Washington: Bur. of Mines.)

Fuller's Earth

German Fuller's Earth. Deposits, Preparation, and Marketing. By R. Deckert. *Eng. and Min. Journ.-Press* (1925, **120**, 848).

Magnesite

Plastic Magnesia. By O. C. Ralston, R. D. Pike, and L. H. Duschak. *Bull.* 236, *U.S. Bur. Mines.* Pp. 111, 9 × 6. (Washington: Government Printing Office, 1925.) Price 30 cents.

Mica

Die Versorgung Mitteleuropas mit Nutzglimmer. By H. Mohr. *Internationale Bergwirtschaft* (1925/26, **1**, 28–32; 134–136).

Zonolite: Utilising a Useless Mineral. By E. N. Alley. *Eng. and Min. Journ.-Press* (1925, **120,** 819–820).

Petroleum and Allied Products

To Develop a Mineral Oil Industry [in South Africa]. Recommendations of the Oil Fuel Committee. *S. Afr. Journ. Indust.* (1925, **8,** 692–693).

Oil Development in Alberta. By G. S. Hume. *Can. Min. Journ.* (1925, **46,** 1067–1068).

Helium in Canada. By J. C. McLennan. *Nature* (1926, **117,** 93).

Report on Petroleum Prospects in parts of Western Victoria, South Australia, and Western Australia. By A. Wade. Pp. 3. (Melbourne: Government Printer.)

The Trend of Petroleum Production. By H. B. Milner. *Mining Mag.* (1925, **33,** 271–286).

La Fabrication du Goudron spécial pour le Revêtement des Routes. By C. Ab-der-Halden. *Chim. et Ind.* (1926, **15,** 14–17).

The Oilfield of Hanigsen-Menhagen. By C. Streich. *Petr. Times* (1926, **15,** 221–222).

The Roumanian Petroleum Industry: a Statistical Review for 1925. *Petr. Times* (1926, **15,** 265–267).

Report on Boring for Oil in Egypt. By T. S. Bowman. Section I, Government Petroleum Research Operations. *Min. Finance, Egypt.* Pp. xii + 67, $10\frac{3}{4} \times 7\frac{1}{2}$. (Cairo: Government Publications Office, 1925.) Price P.T.10.

Sobre la Estructura Tectónica de las Capas Petrolíferas en el Oriente del Territorio del Neuquen. By J. Keidel. *Pub. No. 8, Dir. Gen. de Minas, Geol. e Hidrol., Argentina.* Pp. 67, $10\frac{1}{4} \times 7$. (Buenos Aires: Ministerio de Agricultura de la Nación, 1925.) Price 4 pesos.

Phosphates

The Malmesbury Phosphates. *S. Afr. Min. and Eng. Journ.* (1925, **36,** 271–272).

Potash

Grundlagen und Aufbau der modernen Kali-Industrie. By B. Baumert. *Internationale Bergwirtschaft* (1925/26, **1,** 11–16 and 90–94).

Salt

Salt and Allied Chemicals. A Border Cities Industry [in Canada]. By G. E. Gollop. *Can. Chem. and Met.* (1925, **9,** 259–264).

Silica

Report by the Geological Adviser to Government of Palestine and by the Imperial Institute on Quartz from Malha. *Commercial Bulletin, Jerusalem* (1926, **3,** 27 and 39).

Sulphur

Sulphur Deposits of New Zealand. By E. B. Dow. *Proc. Austr. Inst. Min. and Met., N.S.* (1925, No. 58, pp. 29–46).

How Sulphur is Mined with Superheated Water. By W. T. Lundy. *Chem. and Met. Eng.* (1925, **32,** December, pp. 917–919).

Uranium (Radium) Minerals

L'Industrie des Corps Radioactifs. By C. Matignon and G. Marchal. *Chim. et Indust.* (1925, **14,** 343–357).

NOTICES OF RECENT LITERATURE

METALLURGY AND ITS INFLUENCE ON MODERN PROGRESS, WITH A SURVEY OF EDUCATION AND RESEARCH. By Sir Robert A. Hadfield, Bt., D.Sc., D.Met., F.R.S., F.I.C., M.Inst.C.E. Pp. xvi + 388, 10 × 6. (London: Chapman & Hall, Ltd., 1925.) Price 25s. *net.*

The author's object in preparing this work has been to outline the rise of modern science and then to deal at greater length with those aspects of the work with which he has been particularly associated. The book is divided into five parts, the first being a review of progress in science and metallurgy, while the second deals with alloy steels, the wonderful development of which owes so much to the pioneer research work of Sir Robert Hadfield himself. Part 3 is devoted to fuel economy, which has been studied closely in the author's works. Education and research is the subject of the fourth part, while the future is discussed in Part 5 in relation to war waste, Imperial resources, the British Empire Exhibition, and international co-operation. Several appendices and a good index complete the book.

The historical section, including excellent portraits of famous pioneers, is of absorbing interest, but the extraordinary advance that has taken place since 1875 is most striking. At that date analytical chemistry was still in a comparatively imperfect condition, metallography was unborn, while mechanical and other special forms of testing, including hardness, were in their infancy. Then followed the author's discovery of manganese steel, which formed the starting-point for much of our present-day knowledge of alloy steels and their technology. These are fully described in subsequent pages, with references to the original difficulties that had to be overcome in regard to uniformity of composition, methods of heat-treatment, and prejudices of users. Improvements in the knowledge and practice of pyrometry made at this time had much to do with the success achieved. No less than 50,000 pyrometrical determinations per week were made at the Hadfield works during the war.

The author concludes on an optimistic note with regard to the future of the Empire, the greatness of which was demonstrated by the British Empire Exhibition. The whole book is a record of progress, and, as Sir Robert would desire, is an encouragement and an inspiration to younger men to persevere and carry on the further development of the age of alloy steels.

In conclusion, the publishers are to be congratulated on

the general style and quality of the book. The illustrations are excellent, and the type is clear and distinct.

Economic Geology. By H. Ries, A.M., Ph.D. Pp. v + 843, 9 × 6. Fifth Edition, Revised. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1925.) Price 25*s*.

The first edition of this book was published in 1905, and the fact that it has now reached the fifth edition is evidence of marked popularity. The subject-matter of the book is divided fairly equally into two parts, the first being devoted to non-metallic minerals (pp. 1–425), and the second to ore deposits (pp. 429–779). The first five chapters of the first part deal with coal, petroleum, etc., building stones, clay, limes, and calcareous cements, and occupy pp. 1–209, which indicates that most space is allotted to the most important groups of minerals. The same is true of the second part, in which large spaces are given to the ore-deposits of iron, copper, lead, zinc, gold, and silver. In the accounts given of the deposits of ores and other minerals, attention is directed chiefly to those of North America, a feature presumably explained by the fact that the first three editions of the book bore the title "Economic Geology of the United States." As, however, the book now bears a more general title, the reader is perhaps justified in expecting that deposits other than those of North America should receive fuller and more accurate treatment than the author gives to them. The book is excellently illustrated, the text-figures numbering 291 and the plates 75. Numerous references are given and there is a good index.

An Introduction to Historical Geology, with Special Reference to North America. By William J. Miller. Pp. xvi + 399, 8¾ × 6. (London: Chapman & Hall, Ltd., 1925.) Price 13*s*. 6*d*.

The present issue of this book is a second printing of the second edition, the first printing having been issued in 1922, while the previous edition was first issued in 1916. The book is intended by the author to meet the historical-geology requirements of students taking a one-year course in general geology, and he hopes it will serve also as a text-book for special courses in historical geology. Chapters 1 and 2 (pp. 1–34) deal with general principles, including fossils and their classification, correlation of formations, palæogeography, and the subdivision of geological time. The very modest nature of the author's demands as regards the duration of geological time is indicated by his state-

ment that "the age of the earth must be measured by at least tens of millions of years," in connection with which statement it is not surprising to find that he makes no reference to radioactivity and its results as a basis of estimating the duration and subdivision of geological time. Chapter 3 accounts for the origin and pre-geological history of the earth, as explained by the nebular and planetesimal hypotheses. The rest of the book deals, according to a definite plan, with stratigraphical geology from the Archæan to the Tertiary, and a considerable space is given to the Quaternary Period, including glacial history and an account of the antiquity of man. The book is excellently illustrated, containing 238 text-figures, and serves as a very attractive introduction to the study of historical geology.

CLAY, AND WHAT WE GET FROM IT. By Alfred B. Searle, pp. 178, 7½ × 5. (London: The Sheldon Press, 1925.) Price 3*s*. 6*d*.

In this little book on clay, which is one of the series of works on Popular Science published by the Sheldon Press, the author states that his aim has been to stimulate interest in the subject, in the hope that some of his readers "in whom exists that divine gift of curiosity which makes childhood so enchanting, may find a fresh subject on which to exercise their imagination."

Only the opening chapter is devoted to the nature of clay itself and its origin, and advisedly so, for this is a controversial subject and one not easily explained to the uninitiated. The rest of the book deals chiefly with the industries in which clay is employed. Here the author is thoroughly at home, and he has presented, in simple form, a very interesting account of the practical applications of the various kinds of clay in our industrial and home life. A closing chapter tells us what the prophets and poets have said on the subject of clay.

The work is written in a simple style, and is illustrated fully enough to awaken the interest of the reader.

MONTHLY
MINERAL AND METAL STATISTICS

Second Half-Year, 1925.

Owing to lack of space, only the more important monthly statistics relating to the production and trade of principal minerals and metals can be included in the following pages. Anyone requiring further information on these or other minerals and metals should communicate with the Director, Imperial Institute, South Kensington, London, S.W.7, who will supply such further information as may be available.

Where the descriptions "Imports" and "Exports" are used without qualification in the following pages, "Imports" is equivalent to "Imports for home consumption," while "Exports" represents "Exports of domestic produce."

A blank space in the columns indicates that information has not yet been received; whereas a dash indicates that, so far as can be ascertained, no production or trade took place.

The units of quantity adopted for these returns are the British statute hundredweight and ton of 112 lb. (avdp.) and 2,240 lb. (avdp.) respectively, the imperial gallon and the metric carat. For precious metals the troy ounce has been used.

In those cases where values expressed in pounds sterling are given in place of quantities, these values have been converted to pounds sterling at the average rate of exchange with the exception of those for the Union of South Africa, Australia and New Zealand, where the original currency values have been used.

Total figures given for the whole of the year 1925 should be regarded as provisional only.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
ALUMINIUM								
BRITISH EMPIRE								
United Kingdom:								
Exports of ingots, blocks, etc.	Long ton	349	301	297	377	275	133	3,744
Canada:								
Imports of cryolite . .	Long ton	75	52	112	33	69	3	673
Imports of alumina . .	do.	5,560	4,646	4,176	3,321	3,702	5,329	56,922
Exports of blocks, bars, etc. .	do.	705	618	473	880	1,680	820	16,637
British Guiana:								
Production of bauxite . .	Long ton							194,339
Exports of bauxite . .	do.	19,462	14,068	11,427	11,934	11,201	13,652	174,999
FOREIGN COUNTRIES								
France:								
Production of bauxite . .	Long ton	33,937	33,955	32,765	34,477	31,877	34,361	400,009
Exports of bauxite, etc. .	do.	17,218	20,204	12,521	22,464	15,490	20,919	211,510
Exports of anhydrous alumina	do.	1,551	2,933	2,070	1,853	1,491	1,811	21,188
Exports of hydrate of alumina	do.	510	319	30	218	1,537	87	3,774
Production of aluminium .	do.							21,000
Exports of ingots, scrap and wrought aluminium . .	do.	471	295	281	232	295	173	3,244
Germany:								
Exports of crude bauxite and natural cryolite . . .	Long ton	57	194	—	—	—	—	469
Production of aluminium .	do.							25,000
Exports of crude, scrap and wrought aluminium . .	do.	233	320	316	548	1,800	1,991	7,489
Imports of crude, scrap and wrought aluminium . .	do.	1,114	991	869	433	450	359	9,734
Italy:								
Production of bauxite . .	Long ton							195,000
Production of aluminium .	do.							1,800
Imports of ingots, etc., sheets, bars and tubes . . .	do.	652	1,005	756	858	701	414	6,579

Norway :								
Total imports of bauxite .	£	28,610	63,859	1,007	—	—	55,904	284,202
Total imports of cryolite .	£	1,653	6,070	12,341	9,096	4,738	12,135	75,871
Total imports of alumina .	£	29,523	75,903	76,087	55,025	35,268	80,011	612,272
Exports of ingots and sheets .	Long ton	1,160	1,949	1,712	1,909	1,292	1,761	20,319
Switzerland :								
Exports of blocks, etc., scrap, sheets, tubes and wire, including some alloys . . .	Long ton	1,990	1,310	1,486	849	1,397	1,797	15,639
United States :								
Production of bauxite . .	Long ton							316,540
Total imports of crude bauxite	do.	47,011	26,951	17,917	20,382	35,583	15,826	353,696
Exports of bauxite, etc. . .	do.	10,725	3,858	4,535	8,966	4,936	6,172	78,570
Total imports of cryolite .	do.	—	2,550	2,550	2,500	2,155	64	9,844
Total imports of ingots, scrap, alloys, plates and sheets, etc.	do.	986	1,183	2,032	2,459	2,695	4,855	19,425
Exports of ingots, scrap and alloys, plates and sheets, etc.	do.	522	478	85	155	103	239	5,644
Dutch Guiana :								
Production of bauxite . .	Long ton							(*b*)90,000
Japan :								
Total imports of cryolite	Long ton	130	69	—	93	172		
Total imports of aluminium .	do.	314	470	631	140	386		
ARSENIC								
BRITISH EMPIRE								
Great Britain :								
Production of arsenical pyrites and iron pyrites. . .	Long ton	(*a*)436	(*a*)436	(*a*)436				
Production of arsenic soot and white arsenic . . .	do.	(*a*)194	(*a*)194	(*a*)194				
Southern Rhodesia :								
Production of ore . . .	Long ton	22	5	19	4	—	1	167
Exports of white arsenic .	Cwt.	—	—	—	—	—		
Union of South Africa (Transvaal) :								
Sales and shipments of white arsenic	Cwt.	36	—	18	37	358	36	612

(*a*) *Monthly average of third quarter,* 1925.

(*b*) *Exports were* 84,150 *long tons.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Canada:								
Imports of sulphide of arsenic	Cwt.	43	20	35	2	20	—	196
Domestic exports of white arsenic, etc. . . .	do.	4,077	2,719	838	806	1,022	—	24,426
India:								
Imports from overseas of arsenic and its oxides . .	Cwt.	116	69	100	131	85	220	2,093
Australia:								
Queensland: Production of white arsenic . . .	Cwt.	(*a*)600	(*a*)600	(*a*)600	(*b*)400	(*b*)400	(*b*)400	6,680
Western Australia: Arsenic contained in gold ore exported from the State, not necessarily overseas . .	£	—	—	170	—	—	190	1,065
Foreign Countries								
France:								
Production of ore . . .	Long ton	3,125	1,793	4,008	2,066	354	4,170	28,524
Imports of sulphide of arsenic	Cwt.	—	301	106	12	—	43	577
Exports of sulphide of arsenic	do.	20	45	43	—	57	89	521
Exports of white arsenic .	do.	1,862	4,713	1,507	5,303	2,257	956	21,631
Imports of white arsenic .	do.	746	645	2,519	954	1,484	779	13,472
Germany:								
Imports of ore . . .	Long ton	46	21	—	153	—	20	446
Italy:								
Imports of white arsenic .	Cwt.	689	362	274	1,124	1,549	401	9,625
Mexico:								
Arsenic content of ore and white arsenic produced .	Cwt.	620	8,408	11,288	6,439	5,156	9,330	82,505
United States:								
Total imports of sulphide of arsenic	Cwt.	1,308	11	12	4,317	13	676	8,496
Production of crude white arsenic	do.	9,214	12,000	9,125	9,232	8,786	10,054	149,321

Production of refined white arsenic	do.	14,357	13,375	15,464	13,000	8,982	11,536	197,714
Total imports of white arsenic	do.	15,638	7,338	11,741	15,318	6,632	4,200	166,352
ASBESTOS								
BRITISH EMPIRE								
United Kingdom:								
Total imports of raw asbestos, fibre and waste, including asbestic	Long ton	2,991	2,560	2,393	1,788	1,984	3,152	26,808
Re-exports of raw asbestos, fibre and waste, including asbestic	do.	836	308	500	142	175	680	5,580
Southern Rhodesia:								
Production of asbestos . .	Long ton	2,983	2,873	2,658	3,396	3,138	2,674	30,669
Exports of asbestos . .	do.	3,448	77	—	8,420	3,551		
Union of South Africa:								
Sales and shipments in Transvaal	Long ton	563	784	588	626	617	616	6,810
Sales and shipments in Cape of Good Hope . . .	do.	187	173	164	187	140	349	2,268
Exports from Union of raw asbestos	do.	422	568	620	586	332		
Canada:								
Production of asbestos . .	Long ton							251,485
Exports of asbestos . .	do.	13,010	13,449	10,001	11,013	11,941	8,566	122,098
Exports of asbestos sand (i.e. short fibre) and waste .	do.	8,023	9,115	6,219	10,312	12,255	10,416	108,274
FOREIGN COUNTRIES								
Germany:								
Imports of raw asbestos and fibre.	Long ton	1,013	592	779	946	1,569	726	11,965

(a) *Monthly average of third quarter*, 1925.

(b) *Monthly average of fourth quarter*, 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Italy:								
Production of asbestos . .	Long ton							2,490
Imports of asbestos . .	do.	820	764	384	622	153	513	6,338
Exports of asbestos . .	do.	47	130	73	49	132	114	921
United States:								
Total imports of unmanufactured asbestos . .	Long ton	18,172	17,424	17,858	22,013	19,161	17,564	205,821
Japan:								
Total imports of asbestos in lumps, powder, or fibre .	Long ton	371	1,000	465	172	622		
BARIUM MINERALS								
BRITISH EMPIRE								
United Kingdom:								
Production of unground barytes and witherite in Great Britain	Long ton	(b)3,172	(b)3,172	(b)3,172				
Production of ground barytes and witherite in Great Britain	do.	(b)1,118	(b)1,118	(b)1,118				
Total imports of ground barytes(a) . . .	do.	3,582	3,507	3,747	3,700	3,647	2,956	42,630
Exports of ground barytes(a) .	do.	119	47	100	341	52	511	3,339
Southern Rhodesia:								
Production of barytes . .	Long ton	—	13	—	—	13	—	36
Canada:								
Imports of barytes . .	Long ton	122	171	212	235	287	230	2,173
Australia (Tasmania):								
Production of barytes . .	Long ton	(b)1	(b)1	(b)1	—	—	—	4
FOREIGN COUNTRIES								
France:								
Imports of barytes . .	Long ton	520	535	488	750	890	899	8,557
Exports of barytes . .	do.	103	68	100	82	43	220	1,563
Imports of witherite . .	do.	231	—	20	50	—	31	1,273

Germany :								
Exports of barytes and celestite	Long ton	17,113	15,836	15,623	16,508	14,752	9,577	165,609
Imports of barytes and celestite	do.	207	—	507	—	—	—	2,301
Italy :								
Production of barytes . .	Long ton							31,300
CADMIUM								
Australia :								
Cadmium content of ore produced in Tasmania . .	Lb.	(*b*)343	(*b*)343	(*b*)343	(*c*)709	(*c*)709	(*c*)709	11,750
Cadmium produced in Tasmania from other than Tasmanian ores	do.	(*b*)34,630	(*b*)34,630	(*b*)34,630	(*c*)35,022	(*c*)35,022	(*c*)35,022	388,911
Exports overseas of cadmium from :								
New South Wales . .	do.	24,640	—	—	—	—	—	71,456
Victoria	do.	35,840	11,200	24,640	24,640	36,960	39,200	219,520
Tasmania	do.	2,240	2,240	—	—	—	—	156,324
France :								
Imports of cadmium . .	Lb.	14,106	28,872	3,306	29,974	14,767	14,767	171,471
CHINA CLAY								
EXPORTS FROM BRITISH EMPIRE								
United Kingdom (including Cornish and china stone) . .	Long ton	59,709	44,378	60,327	64,680	43,713	62,356	652,576
EXPORTS FROM FOREIGN COUNTRIES								
Denmark	Long ton	693	375	99	354	98	61	4,136
France	Long ton	226	835	348	250	473	397	5,210
Germany	Long ton	2,993	2,269	2,495	3,691	2,544	3,122	28,455
IMPORTS INTO BRITISH EMPIRE								
Canada	Long ton	948	1,759	1,582	3,089	1,031	1,765	16,245

(*a*) *Including precipitated barium sulphate.* (*b*) *Monthly average of third quarter, 1925.* (*c*) *Monthly average of fourth quarter, 1925.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
India (total imports from overseas)	Long ton	2,000	1,405	1,504	2,733	1,366	1,162	24,531
IMPORTS INTO FOREIGN COUNTRIES								
Denmark	Long ton	964	384	1,018	74	1,005	163	5,310
France	Long ton	3,885	5,073	5,471	5,027	2,203	6,089	54,737
Germany	Long ton	19,802	19,827	17,196	21,037	19,638	14,358	223,022
Italy	Long ton	2,908	3,799	1,919	4,683	3,030	2,666	39,931
United States (total imports)	Long ton	31,217	22,097	23,208	22,550	28,256	26,897	332,622
CHROME ORE								
BRITISH EMPIRE								
Southern Rhodesia:								
Production	Long ton	12,846	14,610	14,317	9,590	13,471	14,226	121,274
Exports	do.	9,375	10,965	8,550	401	30,204		
Union of South Africa:								
Sales and shipments in Transvaal	Long ton	1,804	2,193	1,820	557	—	356	11,137
Exports from Union	do.	—	—	—	111	1		
India:								
Exports overseas	Long ton	2,150	2,250	870	1,000	2,190	800	36,157
FOREIGN COUNTRIES								
Germany:								
Imports	Long ton	1,973	3,759	716	1,239	1,051	11,031	25,468
Norway:								
Total imports of chrome ore	£	13,933	—	—	2,831	—	10,889	34,983
Exports of ferro-chrome	Long ton	301	123	122	87	186	119	2,486
Cuba:								
Production	Long ton							11,655
United States:								
Total imports	Long ton	6,098	8,881	18,234	10,281	12,899	12,848	149,739
New Caledonia:								
Exports	Long ton							18,208

Production of Coal in British Empire								
Great Britain	Long ton	21,221,700	16,461,100	18,709,300	20,894,900	20,363,200	22,526,000	244,418,400
Southern Rhodesia	Long ton	59,453	56,460	55,246	59,246	62,564	65,362	678,320
Union of South Africa (*a*)	Long ton	1,030,734	985,515	1,037,508	1,004,155	1,030,552	1,129,695	13,582,451
Canada:								
Bituminous coal	Long ton	537,000	721,000	794,000	826,000	846,000	865,000	7,980,340
Sub-bituminous coal	do.	21,000	28,000	38,000	51,000	86,000	91,000	509,477
Lignite	do.	109,000	134,000	233,000	525,000	553,000	434,000	3,232,862
India (*d*)	Long ton	1,340,000	1,339,000	1,576,000	1,876,000	1,530,000	1,844,000	19,878,000
Australia:								
New South Wales	Long ton							11,396,199
Western Australia (*b*)	do.	1,399	1,943	3,293	1,259	1,347	1,765	37,511
Tasmania	do.	(*c*)7,415	(*c*)7,415	(*c*)7,415	(*e*)7,228	(*e*)7,228	(*e*)7,228	81,698
Production of Coal in Foreign Countries								
Austria:								
Coal	Long ton	11,319	11,064	11,876	14,755	14,182	14,607	142,077
Brown coal	do.	252,086	234,635	249,348	259,832	259,815	282,279	3,009,597
Belgium	Long ton	1,868,165	1,815,210	1,883,515	2,020,733	1,847,838	1,905,545	22,761,377
Czechoslovakia:								
Coal	Long ton	1,054,220	977,634	1,106,965	1,192,802	1,178,189	1,224,415	12,549,474
Brown coal	do.	1,427,277	1,424,084	1,681,489	1,778,305	1,778,347	1,754,651	18,487,130
France:								
Coal produced in Saar	Long ton	571,523	1,012,127	1,119,369	1,205,283	1,071,948	1,103,623	12,781,084
Coal produced in other districts	do.	3,788,681	3,730,511	3,903,110	4,118,364	3,929,983	3,935,117	46,291,507
Brown coal	do.	76,039	72,188	82,457	90,704	83,176	84,638	991,082
Germany (**excluding Saar**):								
Coal	Long ton	11,059,222	10,883,517	11,172,917	11,757,986	11,009,636	11,184,582	130,595,951
Brown coal	do.	11,463,253	11,278,799	11,757,304	12,554,419	11,748,197	12,508,071	137,543,093

(*a*) *Quantity of coal mined less waste sorted.* (*b*) *Exports from the State, not necessarily overseas, and including bunkers.* (*c*) *Monthly average of third quarter,* 1925. (*d*) *Excluding Indian States.* (*e*) *Monthly average of fourth quarter,* 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Hungary:								
Coal	Long ton	65,856	59,777	66,184	69,623	64,960		6,100,000
Brown coal	do.	378,082	373,521	479,264	563,638	545,530		
Italy:								
Anthracite	Long ton							15,200
Bituminous coal	do.							173,000
Brown coal	do.							956,100
Netherlands (excluding brown coal)	Long ton	613,293	603,682	632,479	665,737	639,806	645,279	7,001,892
Poland:								
Coal	Long ton	2,066,842	2,052,133	2,282,576	2,540,083	2,507,961	2,417,509	28,613,134
Brown coal	do.	4,561	4,658	5,187	5,910			
Russia	Long ton	1,245,000	1,252,000	1,537,000	1,901,000	1,888,000	2,059,000	17,398,000
Algeria	Long ton	811	976	787	447	163	937	9,869
Belgian Congo	Long ton							80,000
United States:								
Anthracite	Long ton	7,404,000	8,005,000	46,000	61,000	135,000	236,000	55,193,883
Bituminous coal	do.	35,341,000	40,074,000	41,801,000	47,503,000	45,339,000	47,157,000	466,935,000
Chile	Long ton	113,849	107,381	115,275	113,633	123,800	114,623	1,417,275
French Indo-China (exports)	Long ton	28,611	46,485	56,399	85,637	70,873		
Japan	Long ton							29,000,000
COBALT								
BRITISH EMPIRE								
Canada:								
Ontario: Production of metal	Cwt.	(b)274	(b)274	(b)274	(c)188	(c)188	(c)188	(a)2,693
Production of oxide	do.	(b)373	(b)373	(b)373	(c)339	(c)339	(c)339	(a)5,139
Production of salts	do.	(b)62	(b)62	(b)62				
Dominion: Exports of metal	do.	295	213	273	239	213	101	2,616
Exports of oxide and salts	do.	248	360	308	609	570	2,617	7,794
Australia (Queensland):								
Production of concentrates	Cwt.	—	—	—	(c)155	(c)155	(c)155	1,607
Exports of ore overseas	do.	970	—	—	1,653	—	2,335	11,884

FOREIGN COUNTRIES								
France :								
Imports of oxide . . .	Cwt.	270	22	445	32	474	303	3,249
Exports of ore . . .	do.	—	—	—	—	1,132	—	1,134
United States :								
Total imports of ore and metal	Cwt.	193	123	119	224	153	64	1,877
Total imports of oxide . .	do.	91	235	212	293	117	387	2,565
Japan :								
Total imports of oxide . .	Cwt.	86	31	221	17	65		
COPPER								
BRITISH EMPIRE								
United Kingdom :								
Total imports of ore, regulus, matte, cement-copper and scale	Long ton	6,535	3,212	689	2,059	5,378	2,223	36,763
Total imports of unwrought copper	do.	13,486	12,438	11,250	13,209	12,864	7,596	144,104
Re-exports of unwrought copper	do.	863	1,744	351	231	133	831	6,858
Exports of unwrought copper .	do.	112	260	307	244	468	472	4,429
Total imports of wrought copper	do.	2,384	1,318	2,077	1,953	1,401	1,612	22,319
Exports of wrought copper .	do.	1,676	1,407	1,550	1,738	1,727	1,931	20,872
Northern Rhodesia :								
Smelter output . . .	Long ton	3	(*d*)44	4	—	—	—	(*d*)68
Southern Rhodesia :								
Smelter output . . .	Long ton	192	196	105	73	—	—	1,686
South-West Africa Territory :								
Exports of copper ore . .	Long ton	10,038	666	992	1,598	11,056		
Union of South Africa :								
Copper content of marketable products :								
Transvaal	Long ton	492	410	492	529	460	386	5,482
Cape of Good Hope . .	do.	233	209	231	196	229	207	2,614

(*a*) *The total metal content of Canadian cobalt ores and products was* 9,969 *long cwt.* (*b*) *Monthly average of third quarter,* 1925. (*c*) *Monthly average of fourth quarter,* 1925. (*d*) *Including adjustment for period* 1920–1924.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Canada:								
Copper content of ore produced in the Dominion	Long ton							49,740
Copper content of matte exported from Ontario	do.	(a)621	(a)621	(a)621	(d)1,061	(d)1,061	(d)1,061	8,963
Smelter output in the Dominion	do.	1,472	2,065	2,196	2,768	2,418	3,013	24,735
Exports from the Dominion:								
Copper content of ore, matte and regulus	do.	1,177	2,751	2,174	815	2,757	4,202	27,021
Blister copper	do.	768	2,061	2,625	1,857	1,324	2,407	21,678
Unwrought copper and scrap	do.	83	263	387	123	280	167	2,502
Imports into the Dominion:								
Unwrought copper and scrap	do.	486	404	349	501	476	583	5,403
Wrought copper	do.	1,278	1,052	1,828	1,187	1,253	932	13,704
India:								
Production of matte in Burma	Long ton	(a)748	(a)748	(a)748	750	800	845	8,029
Australia:								
Queensland: Copper content of ore produced	Long ton	(a)373	(a)373	(a)373	(d)224	(d)224	(d)224	3,989
Tasmania:								
Copper content of ore produced	Long ton	(a)618	(a)618	(a)618	(d)537	(d)537	(d)537	6,539
Commonwealth:								
Output of blister copper	Long ton	661	782	945	554	772	1,421	11,448
Value of matte and ingots exported	£	37,825	13,870	32,964	33,579	41	46,778	242,366
FOREIGN COUNTRIES								
Austria:								
Production of ore	Long ton	7,610	6,653	6,956	7,109	6,623	6,481	79,332
France:								
Production of ore	Long ton	3	4	1,062	512	644	478	2,736

Germany :								
Imports of ore, matte and calcined cupreous pyrites .	Long ton	18,661	10,087	17,539	10,290	9,275	21,492	(b)84,863
Exports of ore, matte and calcined cupreous pyrites .	do.	5,504	133	1,746	4,883	2,923	5,050	20,773
Imports of unwrought copper.	do.	18,343	18,495	15,844	10,887	9,535	8,828	207,567
Exports of unwrought copper.	do.	1,055	1,562	1,504	2,371	3,402	3,104	17,635
Imports of wrought copper .	do.	45	23	29	44	31	12	380
Exports of wrought copper .	do.	2,421	2,198	1,770	3,068	2,684	3,052	29,018
Italy :								
Production of ore . . .	Long ton							6,070
Smelter production . .	do.							492
Spain :								
Copper content of ore produced	Long ton							30,000
Algeria :								
Production of ore . . .	Long ton	121	141	73	269	231	157	1,722
Belgian Congo :								
Smelter output . . .	Long ton	8,079	8,931	7,277	7,639	7,343	5,889	88,168
Cuba :								
Copper content of ore produced	Long ton							10,592
Mexico :								
Copper content of ore production	Long ton	3,336	4,454	4,158	5,436	4,596	8,126	50,511
Smelter output . . .	do.	2,678	2,104	2,922	3,274	3,123	3,324	32,365
United States :								
Copper content of total imports of ore, concentrates, matte and regulus . .	Long ton	4,697	5,791	3,875	5,331	5,891	4,843	72,915
Primary copper obtained from U.S. mines . . .	do.	61,167	60,795	60,464	63,231	60,179	62,113	751,890
Smelter output . . .	do.	68,156	65,054	68,367	74,320	70,217	70,790	846,542

(a) *Monthly average of third quarter*, 1925.
(c) *Copper content of ore produced.*
(b) *This figure is given as a revised figure in the official returns.*
(d) *Monthly average of fourth quarter*, 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
United States (*continued*):								
Total imports of unrefined copper	Long ton	14,997	20,812	15,014	13,384	12,761	14,645	169,345
Total imports of refined copper	do.	1,993	3,441	4,480	3,613	5,827	6,348	44,542
Exports of refined copper	do.	45,639	32,970	29,589	26,649	26,432	29,882	432,171
Total imports of scrap	do.	205	442	379	565	398	265	4,655
Exports of scrap	do.	472	308	341	114	441	112	5,404
Exports of wrought copper	do.	634	904	886	801	402	950	11,899
Bolivia:								
Exports of ore	Long ton	1,207	996	1,802	1,103	775	1,114	14,423
Chile:								
Production of copper bar	Long ton	13,631	13,603	14,086	16,386	16,080	15,965	173,165
Copper content of bar, etc., exported	do.	15,039	15,265	10,435	16,600	14,967	10,585	153,820
Peru:								
Smelter output	Long ton	3,383	2,606	4,091	4,312	3,973	3,822	38,428
Exports of ore (*b*)	do.	249	80	92	—	89	100	922
Exports of matte (*b*)	do.	51	130	169	69	80	59	951
Exports of concentrates (*b*)	do.	—	102	50	51	46	—	554
Exports of bars	do.	6,154	4,392	3,700	4,194	3,569	4,832	36,208
Japan:								
Smelter output	Long ton	5,068	5,728	5,095	5,500	5,000	5,000	64,400
DIAMONDS								
BRITISH EMPIRE								
Gold Coast:								
Exports	Metric carat	13,659	9,122	8,518	12,320		12,856	77,314
Southern Rhodesia:								
Production	Metric carat	(*c*)13	(*c*)13	—	46	(*a*)13	(*a*)13	189
Exports	do.	37	192	14	—	25		
South-West Africa Territory:								
Exports	Metric carat	41,536	43,023	45,403	45,912	44,250		
Union of South Africa:								
Production	Metric carat	198,323	203,374	206,002	216,667	200,194	214,892	2,430,128
Exports	do.	315,544	121,078	127,867	127,530	429,527		

Canada:								
Imports of unset diamonds	£	75,204	57,627	68,177	48,673	66,178	40,376	587,693
Imports of diamond dust or bort and black diamonds for borers	£	23,165	23,336	6,169	741	15,389	1,757	107,869
British Guiana:								
Exports	Metric carat	18,904	21,571	10,095	18,903	19,394	21,121	193,198*
Ceylon:								
Imports	Metric carat	12	87	—	£240	—	6	1,052
India:								
Total imports from overseas	£	51,233	52,295	49,329	60,471	56,752	37,460	536,285
FOREIGN COUNTRIES								
United States:								
Total imports of unset diamonds for glaziers, engravers and miners	Metric carat	3,895	1,230	3,095	3,507	4,638	7,311	46,556
Total imports of uncut diamonds	do.	10,310	9,921	17,038	16,617	25,479	10,916	171,842
Total imports of cut diamonds, unset	do.	34,712	43,672	45,665	47,307	45,177	38,457	513,783
Total imports of diamond dust	£	7,647	3,632	5,628	38,938	11,205	46,830	157,482
GOLD								
PRODUCTION IN BRITISH EMPIRE								
Anglo-Egyptian Sudan (exports of bullion)	Troy oz.	354	692	765	880	420	1,094	8,745
Gold Coast	Fine troy oz.	14,100	15,410	13,700	15,670	15,000	15,600	190,930
Northern Rhodesia	Fine troy oz.	216	—	169	—	197	—	1,249
Southern Rhodesia	Fine troy oz.	49,453	49,245	48,319	48,896	50,364	49,307	581,504

(a) *Monthly average of November and December.* (b) *Copper is also contained in mixed ores, etc., exported.*
(c) *Monthly average of July and August.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Union of South Africa:								
Total production	Fine troy oz.	818,426	805,968	802,059	815,402	791,216	781,071	9,597,592
By districts: Witwatersrand	do.	796,225	785,145	779,769	792,884	769,445	758,771	9,341,048
Other Transvaal	do.	22,198	20,823	22,290	22,518	21,770	22,300	256,525
Natal	do.	3	—	—	—	1	—	19
Canada (Ontario):								
Total crude bullion produced(*a*)	Troy oz.	129,610	130,690	123,920	113,880	112,930	129,830	(*b*)1,465,774
By districts: Porcupine	do.	104,667	109,680	102,049	91,613	90,702	105,072	1,204,040
Kirkland Lake	do.	24,931	21,002	21,863	22,261	22,223	24,746	261,473
Miscellaneous	do.							261
British Guiana (exports)	Troy oz.	1,039	778	953	758	522	813	6,974
Federated Malay States:								
Pahang (exports)	Troy oz.	900	904	902	917	974	1,899	12,496
Perak	do.	257	169	102	81	40	30	1,659
India	Fine troy oz.	32,542	33,747	32,852	32,858	31,499	33,821	392,874
Australia:								
New South Wales	Fine troy oz.	2,205	2,105	1,622	1,043	1,015	1,427	19,422
Victoria	do.	4,737	2,644	6,077	7,096	3,876	1,104	47,296
Queensland	do.	6,309	3,490	652	1,067	6,604	1,337	44,332
Western Australia	do.	34,576	44,131	34,839	38,663	35,099	44,237	441,252
Tasmania	do.	(*c*)344	(*c*)344	(*c*)344	(*e*)352	(*e*)352	(*e*)352	3,524
Commonwealth	do.							556,000
New Zealand (exports)	Troy oz.	11,221	9,942	9,440	12,593	9,919	5,631	(*d*)114,696
PRODUCTION IN FOREIGN COUNTRIES								
France (gold ores)	Long ton	4,279	4,568	4,526	4,841	4,319	4,865	56,706
Italy (refinery production)	Troy oz.							2,250
Russia	Fine troy oz.							735,000
Belgian Congo (Kilo Moto)	Troy oz.							115,901
Madagascar (exports)	Troy oz.	(*c*)288	(*c*)288	(*c*)288	(*e*)982	(*e*)982	(*e*)982	6,336
Mexico	Fine troy oz.	69,219	60,401	67,354	73,881	64,043	67,483	788,993
United States	Fine troy oz.							2,376,514

Bolivia :								
Quantity of gold exported	Troy oz.	—	—	96	—	—	96	386
Value of gold exported	£	—	—	274	—	—	396	1,274
Brazil	Fine troy oz.							116,000
Ecuador	Fine troy oz.							43,000
Japan	Fine troy oz.							280,000
Philippine Islands (exports of bullion)	Troy oz.	13,798	12,844	13,592	12,886	14,800	13,614	159,580
GRAPHITE								
BRITISH EMPIRE								
Union of South Africa (Transvaal) :								
Sales and shipments	Long ton	5	4	4	7	2	1	44
Canada :								
Exports	Long ton	189	197	141	173	165	246	2,218
Imports of unground graphite	£	—	64	—	—	10	—	159
Imports of crucibles	£	478	366	2,584	950	781	982	10,254
Ceylon :								
Exports	Long ton	1,195	953	1,618	1,279	1,564	1,409	13,886
India :								
Total imports of graphite from overseas	Long ton	19	6	14	9	12	6	172
Total imports of crucibles from overseas	do.	27	17	15	14	15	19	264
FOREIGN COUNTRIES								
France :								
Imports	Long ton	80	748	523	711	793	571	8,228
Exports	do.	16	417	118	337	120	458	3,519
Germany :								
Imports	Long ton	2,133	2,055	1,779	1,835	1,582	1,087	23,342
Exports	do.	218	186	225	236	172	265	2,662

(a) *Including a small amount of silver.* (b) *Gold content of ore produced in the Dominion was* 1,740,386 *fine troy ounces.*
(c) *Monthly average of third quarter,* 1925. (d) *Production was about* 120,000 *troy ounces.* (e) *Monthly average of fourth quarter,* 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Italy:								
Production	Long ton							9,000
Imports	do.	351	204	126	226	115	32	1,624
Exports	do.	321	436	280	379	374	835	5,242
Madagascar:								
Exports	Long ton	(*a*) 866	(*a*) 866	(*a*) 866	(*b*) 1,440	(*b*) 1,440	(*b*) 1,440	14,739
Mexico:								
Production	Long ton	53	—	—	251	524	966	5,745
United States:								
Total imports	Long ton	797	773	717	1,020	1,629	2,524	15,875
Exports	do.	27	82	57	63	42	74	843
Japan:								
Exports	Long ton	253	649	436	359	440		
GYPSUM								
BRITISH EMPIRE								
Canada:								
Production of gypsum	Long ton							652,709
Exports of crude gypsum	do.	57,786	59,420	59,135	71,339	60,089	58,576	476,469
Imports of crude gypsum	do.	37	39	403	548	756	75	3,958
Imports of ground gypsum	do.	5	3	27	5	16	13	105
Exports of plaster of Paris, etc.	do.	1,010	472	473	315	459	532	5,038
Imports of plaster of Paris, etc.	do.	516	440	615	339	292	247	3,902
FOREIGN COUNTRIES								
France:								
Exports of plaster of Paris	Long ton	9,781	21,993	24,172	16,426	20,592	12,473	206,425
Imports of plaster of Paris	do.	696	762	3,380	476	816	547	13,912
Germany:								
Exports of gypsum and superphosphate	Long ton	9,655	8,562	8,775	9,350	9,173	6,402	109,021
Imports of gypsum and superphosphate	do.	577	675	906	680	544	140	7,473

Italy:								
Exports of gypsum	Long ton	72	135	49	34	55	80	1,186
Imports of gypsum	do.	269	327	107	210	282	195	2,922
Production of alabaster	do.							14,000
Exports of crude alabaster	do.	288	86	289	223	355	230	3,078
United States:								
Total imports of crude gypsum	Long ton	72,460	55,782	99,425	64,299	59,235	73,536	566,449
IRON ORE								
BRITISH EMPIRE								
United Kingdom:								
Total production in Great Britain	Long ton	(a)758,179	(a)758,179	(a)758,179				
By kinds:								
West coast hematite (non-phosphoric)	do.	(a)48,052	(a)48,052	(a)48,052				
Jurassic ironstones:								
Lower Lias	do.	(a)171,226	(a)171,226	(a)171,226				
Middle Lias: Cleveland	do.	(a)184,404	(a)184,404	(a)184,404				
Other	do.	(a)91,836	(a)91,836	(a)91,836				
Inferior Oolite	do.	(a)231,710	(a)231,710	(a)231,710				
Coal measure ironstones	do.	(a)21,311	(a)21,311	(a)21,311				
Other hematite, brown ore, etc.	do.	(a)9,640	(a)9,640	(a)9,640				
Total imports	do.	331,739	237,646	364,205	318,118	339,222	365,908	4,374,755
Exports	do.	1	161	51	169	279	180	2,582
Southern Rhodesia:								
Production	Long ton	—	—	70	271	218	215	1,046
Canada:								
Imports	Long ton	151,370	201,016	102,887	144,287	104,044	94,526	926,094
Exports	do.	1,250	71	71	683	54	36	3,932
British Malaya:								
Exports	Long ton	23,625	23,766	17,950	23,042	19,690	24,728	271,995
Australia (Queensland):								
Production	Long ton	(a) 101	(a) 101	(a) 101	—	—	—	303

(a) *Monthly average of third quarter*, 1925. (b) *Monthly average of fourth quarter*, 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
FOREIGN COUNTRIES								
Austria:								
Production in Styria and Carinthia	Long ton	135,221	117,502	114,614	79,027	85,320	86,606	1,003,984
France:								
Total extracted	Long ton	2,974,908	2,920,633	3,040,608	3,218,314	2,981,882	3,079,542	35,166,783
Of which, merchantable ore:								
Non-phosphoric	do.	22,275	19,523	17,772	19,906	17,187	21,987	241,805
Slightly phosphoric	do.	128,996	125,926	130,260	134,674	126,204	121,697	1,482,746
Phosphoric	do.	2,801,711	2,753,085	2,867,332	3,035,467	2,811,973	2,909,801	33,158,521
Exports	do.	723,924	683,730	711,753	664,942	655,936	580,663	9,078,408
Imports	do.	171,102	122,086	105,589	136,689	78,471	76,410	1,218,142
Germany:								
Imports	Long ton	1,143,300	1,758,790	729,273	749,622	633,408	602,030	11,354,546
Exports	do.	25,313	21,308	18,548	35,273	14,931	11,782	198,500
Italy:								
Production	Long ton							(a)466,600
Imports	do.	54,618	57,851	31,629	54,270	19,288	12,893	304,314
Norway:								
Exports	Long ton	96,124	23,111	24,267	5,278	27,387	9,453	417,836
Sweden:								
Exports	Long ton	1,046,079	952,978	922,375	863,132	690,797	368,950	8,651,249
Switzerland:								
Exports	Long ton	10,631	7,956	5,214	2,106	3,204	1,429	58,572
Imports	do.	7,842	4,255	3,374	3,581	4,215	2,163	41,750
Algeria:								
Total extracted	Long ton	133,870	146,281	144,871	150,410	141,584	150,198	1,772,228
Of which, merchantable ore:								
Non-phosphoric	do.	132,368	142,734	140,240	149,525	141,346	146,396	1,731,690
Slightly phosphoric	do.	1,502	2,668	3,720	—	—	2,951	25,666
Tunis:								
Production (all non-phosphoric)	Long ton	58,000	59,000	48,000	48,000	52,000	59,000	711,000
Cuba:								
Production	Long ton							900,000

United States:								
Production	Long ton							(b)62,079,000
Shipments from mines through Upper Lake Ports	do.	8,525,000	8,533,000	7,355,000	7,004,000	4,258,000	7,000	54,075,000
Total imports	do.	173,654	170,660	92,693	204,317	246,403	240,049	2,190,697
Exports	do.	191,644	71,998	91,987	105,526	42,266	1,128	630,700
Chile:								
Exports	Long ton	101,258	100,744	106,138	107,890	128,628	151,937	1,214,258
Japan:								
Total imports	Long ton	81,593	86,685	91,341	111,334	113,956		
LEAD								
BRITISH EMPIRE								
United Kingdom:								
Lead content of ore produced in Great Britain	Long ton	(d)1,001	(d)1,001	(d)1,001				
Smelter output	do.	(c)355	(c)355	(c)355	(c)355	(c)355	(c)355	4,735
Total imports of pig-lead and sheets	do.	27,367	23,414	19,163	25,758	19,943	30,132	275,494
Re-exports of pig-lead and sheets	do.	733	974	892	1,717	1,467	2,212	14,474
Exports of pig-lead	do.	419	523	726	412	431	373	6,428
Exports of wrought lead	do.	573	582	520	466	595	497	6,634
Northern Rhodesia:								
Smelter output	Long ton	542	495	360	384	198	259	2,993
Exports of pig-lead	do.	589	330	433	472	33		
Southern Rhodesia:								
Lead content of ore produced	Long ton	—	—	—	—	4	—	4
South-West Africa Territory:								
Exports of pig-lead	Long ton	23	199	83	—	445		
Union of South Africa:								
Lead content of sales and shipments of ore:								
Transvaal	Long ton	140	206	113	100	1	6	1,602
Cape of Good Hope	do.	7	7	8	14	14	21	127
Smelter output in Transvaal	do.	150	173	77	90	100	—	1,205

(a) *Excluding manganiferous ore.* (b) *Excluding ore containing more than 5 per cent. Mn.* (c) *Monthly average of second half-year, 1925.* (d) *Monthly average of third quarter, 1925.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Canada:								
Lead content of ore produced	Long ton							113,039
Lead content of ore exported .	do.	1,399	577	916	1,088	819	638	16,743
Smelter output . . .	do.	8,452	9,034	8,844	9,930	9,674	9,616	110,962
Exports of pig-lead . .	do.	7,638	4,073	6,593	6,775	5,708	7,934	71,487
India:								
Refinery output in Burma .	Long ton	3,804	3,804	4,000	4,001	4,393	4,500	47,665
Exports overseas of pig-lead .	do.	4,929	3,725	3,065	2,889	3,698	3,478	41,137
Total imports from overseas of wrought lead . . .	do.	113	147	201	152	172	154	2,394
Australia:								
Lead content of ore produced in:								
Queensland	Long ton	(a)285	(a)285	(a)285	(b)361	(b)361	(b)361	4,836
Tasmania	do.	(a)515	(a)515	(a)515	(b)510	(b)510	(b)510	5,526
Exports overseas of ore and concentrates from:								
Victoria (ore)	do.	—	—	85	—	—	—	86
Western Australia (concentrates)	do.	—	916	327	581	124	496	4,823
South Australia (concentrates)	do.	—	33	—	—	7,620	5,026	29,877
Exports overseas of silver-lead ore and concentrates from:								
New South Wales . .	do.	240	95	4	142	16	135	986
Western Australia . .	do.	—	—	—	—	43	44	87
Queensland . . .	do.	105	—	—	—	—	264	1,162
South Australia. . .	do.	—	—	21	—	749	—	770
Tasmania	do.	—	1,574	—	—	—	2,458	7,117
Smelter output in Commonwealth	do.	12,915	11,686	13,730	13,980	14,000	15,840	150,900

Exports overseas of pig-lead from:								
New South Wales . .	do.	6,513	2,020	4,424	5,808	4,750	4,616	73,796
Queensland (silver-lead bullion)	do.	874	—	—	—	—	—	3,037
South Australia . . .	do.	6,275	6,500	7,977	8,147	3,766	1,829	43,652
Value of matte and pig-lead exported from Commonwealth	£	448,349	421,271	186,806	783,264	314,961	325,245	4,718,275
FOREIGN COUNTRIES								
Austria:								
Carinthia:								
Production of lead ore .	Long ton	585	611	598	130	627	557	5,527
Production of wulfenite .	Cwt.	33	20	71	77	22	4	382
Smelter output . . .	Long ton	368	293	330	1,031	597	508	5,322
Tyrol: Production of lead ore.	do.	805	658	574	640	640	640	7,424
France:								
Production of lead ore . .	Long ton	1,268	1,217	1,069	1,264	898	2,268	16,020
Imports of ore . . .	do.	4,023	1,847	4,787	1,699	184	1,528	30,400
Exports of ore . . .	do.	364	406	947	732	1,750	927	8,623
Imports of pig-lead and scrap.	do.	6,489	5,624	6,555	5,675	5,410	4,253	70,325
Exports of pig-lead and scrap.	do.	114	161	217	360	155	706	2,849
Germany:								
Imports of ore . . .	Long ton	874	3,442	1,348	2,935	12,878	3,729	34,705
Exports of ore . . .	do.	867	326	1,439	445	219	450	7,174
Smelter output . . .	do.							46,000
Imports of pig-lead and scrap.	do.	12,632	9,894	10,012	7,552	6,765	5,147	135,531
Exports of pig-lead and scrap.	do.	955	1,444	1,112	1,555	3,059	1,836	15,087
Exports of wrought lead .	do.	337	361	292	287	205	381	3,545
Italy:								
Production of ore . . .	Long ton							48,060
Imports of ore, including argentiferous . . .	do.	2,574	1	19	318	1,259	14	6,980

(a) *Monthly average of third quarter*, 1925.

(b) *Monthly average of fourth quarter*, 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Italy (*continued*):								
Exports of ore, including argentiferous	Long ton	235	4,077	1,159	760	566	861	12,519
Smelter output	do.	2,044	2,312	1,771	2,021	2,127	2,838	22,900
Imports of pig-lead and scrap(*a*)	do.	838	2,762	1,167	1,470	1,289	2,446	26,183
Exports of pig-lead and scrap(*a*)	do.	3	751	302	6	7	23	8,532
Spain and Tunis:								
Smelter output	Long ton	8,228	7,333	9,435	10,025	9,564	11,000	114,680
Upper Silesia:								
Production of ore	Long ton	1,636	1,629	1,527	2,237	2,569	2,018	19,013
Smelter production	do.	1,755	1,191	2,061	2,395	2,151	1,652	20,980
Algeria:								
Production of ore	Long ton	1,111	1,020	1,338	964	3,557	1,021	15,369
Tunis:								
Production of ore (see Spain)	Long ton	2,972	2,499	2,686	3,198	3,247	3,719	36,494
Mexico:								
Lead content of ore produced	Long ton	15,563	13,615	13,141	14,297	10,579	15,881	169,006
Smelter output (*b*)	do.	15,364	14,853	15,176	15,909	14,594	13,631	181,491
United States:								
Lead content of ore produced	Long ton	38,489	38,025	41,412	42,332	43,101	45,252	493,599
Smelter output	do.	41,564	41,270	39,584	47,257	43,955	46,265	511,373
Lead content of total imports of:								
Ore and matte	do.	2,717	4,562	2,142	3,650	3,073	3,394	39,715
Bullion and base bullion	do.	2,185	4,078	5,460	3,383	6,356	8,673	63,059
Pig-lead and bars	do.	856	9	6	—	76	625	5,713
Scrap, babbitt metal, solder, etc.	do.	23	41	58	64	26	10	556
Type metal and antimonial lead	do.	(*c*)	—	45	25	722	750	1,924
Exports of pig-lead, bars, etc., produced from:								
Domestic ore	do.	151	767	166	111	836	986	4,425
Foreign ore	do.	8,029	6,749	4,430	4,353	4,518	4,632	87,428

Argentina :								
Smelter output . . .	Long ton							7,700
Bolivia :								
Exports of ore, etc. . .	Long ton	3,123	2,692	3,050	3,250	3,337	2,526	36,246
MAGNESITE								
BRITISH EMPIRE								
Union of South Africa (Transvaal):								
Sales and shipments of crude magnesite . . .	Long ton	197	240	202	137	180	137	1,795
Canada :								
Exports of calcined and dead-burnt magnesite . .	Long ton	36	5	234	23	261	50	745
FOREIGN COUNTRIES								
Germany :								
Imports of crude and calcined magnesite . . .	Long ton	5,262	3,917	5,594	3,459	3,815	4,154	54,062
Exports of crude and calcined magnesite . . .	do.	348	431	357	615	258	313	3,813
Italy :								
Production of magnesite .	Long ton							12,500
United States :								
Total imports of crude magnesite	Long ton	2,469	6,188	4,075	1,215	801	1,911	61,712
MANGANESE ORE								
BRITISH EMPIRE								
United Kingdom :								
Total imports . . .	Long ton	28,406	14,526	20,032	6,661	12,072	13,119	278,620
Re-exports	do.	62	—	841	—	—	—	1,370

(a) Including antimonial lead.
(b) Including lead produced in the United States from Mexican ore, which averaged 2,500 long tons per month during 1924.
(c) Less than ½ ton.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Gold Coast:								
Exports	Long ton							330,000
Union of South Africa (Transvaal):								
Sales and shipments	Long ton	43	43	36	58	29	11	448
Canada:								
Exports	Long ton	31	—	—	66	—	37	434
India:								
Exports overseas	Long ton	57,453	23,549	39,642	41,727	33,654	48,210	604,198
FOREIGN COUNTRIES								
France:								
Production	Long ton	266	252	274	261	239	252	3,134
Imports	do.	31,415	45,660	29,143	43,255	34,830	52,898	462,015
Exports	do.	40	108	262	300	269	335	1,696
Germany:								
Imports	Long ton	21,700	9,454	5,848	4,112	4,769	3,003	196,171
Exports	do.	(a)	—	32	315	—	10	360
Italy:								
Production	Long ton							12,565
Imports	do.	5,859	5,131	1,003	2,730	6,425	6,302	67,659
Exports	do.	225	214	157	162	147	173	2,553
Russia:								
Production in Tchiaturi	Long ton			62,000		71,000		(d)512,721
Tunis:								
Production	Long ton	79	69	83	31	49		1,702
United States:								
Total imports	Long ton	1,923	66	92	128	1,021	4,563	12,745
Brazil:								
Exports	Long ton	36,987	28,239	18,006	24,915	35,917	23,122	306,870
Japan:								
Total imports	Long ton	2,303	6,102	5,607	5,781	3,774		
Exports	do.	45	49	34	75	144		

MICA								
British Empire								
United Kingdom:								
Total imports	Long ton	183	204	129	303	157	188	2,688
Re-exports	do.	92	46	55	136	101	88	1,383
Southern Rhodesia:								
Production	Long ton	11	10	15	11	4	11	130
Exports	do.	7	7	16	8	13		
Union of South Africa:								
Production	Long ton	194	197	174	123	(a)	80	1,439
Exports	do	57	93	104	—	43		
Canada:								
Exports of: Scrap and waste.	Long ton	153	311	383	693	973	423	4,457
Rough cobbed and thumb-trimmed mica. . .	do.	—	2	5	—	5	3	25
Splittings	do.	17	12	11	16	11	20	206
India:								
Exports of blocks . . .	Long ton	71	35	38	21	66	37	748
Exports of splittings . .	do.	339	242	322	255	343	303	4,237
Foreign Countries								
France:								
Imports	Long ton	28	90	25	110	23	46	736
Exports	do.	16	6	42	21	76	10	402
Germany:								
Imports	Long ton	146	113	152	74	52	33	1,223
Madagascar:								
Exports of muscovite . .	Long ton	(b)2	(b)2	(b)2	(c)2	(c)2	(c)2	36
Exports of phlogopite, etc. .	do.	(b)20	(b)20	(b)20	(c)12	(c)12	(c)12	226
United States:								
Exports	Long ton	106	136	76	67	76	56	1,081
Imports	do.	23	21	20	17	26	20	280

(a) *Less than ½ ton.* (b) *Monthly average of third quarter, 1925.* (c) *Monthly average of fourth quarter, 1925.*
(d) *Production for the whole of Russia during year ended September, 1925.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
NICKEL								
BRITISH EMPIRE								
Canada:								
Production in Ontario:								
Nickel in matte exported	Long ton	(a)1,114	(a)1,114	(a)1,114	(c)1,624	(c)1,624	(c)1,624	14,580
Nickel	do.	(a)1,419	(a)1,419	(a)1,419	(c)1,543	(c)1,543	(c)1,543	14,337
Nickel oxide and salts	do.	(a)586	(a)586	(a)586	(c)292	(c)292	(c)292	5,256
Exports:								
Nickel content of ore, matte or speiss	do.	909	1,780	513	976	2,800	2,167	17,950
Nickel	do.	1,145	1,083	1,380	1,700	1,992	1,812	13,445
Imports of nickel and nickel-silver	do.	100	18	44	14	20	10	473
India:								
Total imports of nickel and alloys	Long ton	93	79	74	93	77	82	969
FOREIGN COUNTRIES								
France:								
Imports of ore, matte and speiss	Long ton	—	(b)	226	441	276	5	1,548
Imports of nickel and nickel-silver	do.	43	153	79	132	98	78	901
Exports of nickel and nickel-silver	do.	40	54	43	49	103	54	514
Germany:								
Imports of ore	Long ton	76	489	31	—	83	144	2,753
Imports of unwrought nickel, scrap and coin	do	269	192	151	78	122	33	2,481
Exports of unwrought nickel, scrap and coin	do.	38	65	87	69	19	56	659
United States:								
Total imports of ore and matte	Long ton	244	146	224	570	380	693	4,425

Total imports of nickel and nickel-silver . . .	do.	1,106	1,355	1,359	1,904	2,065	1,697	14,302
Exports of nickel-silver . .	do.	20	17	8	14	14	69	220
NITRATES								
BRITISH EMPIRE								
United Kingdom:								
Total imports of:								
Nitrate of potash . .	Long ton	199	316	297	733	635	511	5,107
Nitrate of soda . . .	do.	539	9,184	7,078	6,183	4,757	5,356	81,324
Union of South Africa:								
Total imports of:								
Nitrates for manufacturing purposes . . .	Long ton	49	7,314	7,484	(b)	3		
Canada:								
Imports of:								
Nitrate of potash . .	Long ton	38	99	26	46	129	9	604
Nitrate of soda . . .	do.	4,323	933	360	2,891	629	1,769	19,751
Ceylon:								
Imports of:								
Nitrate of potash refuse .	Long ton	261	447	73	249	378	206	3,493
Nitrate of soda . . .	do.	—	97	347	638	438	150	2,902
India:								
Exports overseas of nitrate of potash	Long ton	438	520	330	403	363	676	6,349
Total imports from overseas of nitrate of soda . . .	do.	311	281	472	280	208	660	4,053
FOREIGN COUNTRIES								
Denmark:								
Total imports of:								
Nitrate of soda . . .	Long ton	149	436	168	7	4,672	958	55,111
Nitrate of lime . . .	do.	187	3,295	4,110	5,615	4,900	148	76,671

(a) *Monthly average of third quarter,* 1925. (b) *Less than ½ ton.* (c) *Monthly average of fourth quarter,* 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
France :								
Exports of nitrate of potash	Long ton	1,084	877	957	642	791	428	6,254
Imports of nitrate of soda	do.	12,011	17,801	35,501	40,923	9,914	26,492	321,085
Exports of nitrate of soda	do.	999	142	16	306	35	131	3,078
Imports of nitrate and cyanamide of lime	do.	647	875	819	1,327	3,351	6,201	28,988
Germany :								
Exports of nitrate of potash	Long ton	1,479	1,860	998	1,212	1,301	1,062	16,029
Imports of nitrate of soda	do.	558	94	2,385	2,531	486	1,787	24,133
Exports of nitrate of soda	do.	1,351	1,092	1,511	2,057	1,998	835	15,180
Italy :								
Imports of :								
Nitrate of potash	Long ton	198	168	259	29	97	499	2,166
Nitrate of soda	do.	772	430	1,800	933	1,513	3,201	63,275
Norway :								
Exports of :								
Nitrate of soda	Long ton	2,426	2,658	2,196	4,279	2,434	3,044	30,619
Nitrate of lime	do.	44	2,395	11,146	13,673	16,793	12,379	154,442
Sweden :								
Imports of :								
Nitrate of soda	Long ton	91	62	73	486	650	77	35,483
Nitrate of lime	do.	226	—	—	779	1,445	2,596	12,430
Egypt :								
Total imports of :								
Nitrate of soda	Long ton	5,496	24,399	24,018	23,235	34,734	13,871	170,971
Nitrate of lime	do.	3,111	30	2,540	2,854	—	246	14,261
United States :								
Total imports of :								
Nitrate of potash	Long ton	49	4,020	729	421	259	268	8,396
Nitrate of soda	do.	68,791	92,082	56,764	48,587	73,892	43,018	1,112,226
Nitrate of lime	do.	11	432	548	34	2,911	72	7,777
Chile :								
Production of :								
Nitrate of soda	Long ton	212,838	220,978	203,422	223,578	230,553	236,581	2,479,446

Japan:								
Total imports of:								
Nitrate of soda . . .	Long ton	2,133	1,545	3,468	1,949	5,063		
PETROLEUM INCLUDING SHALE OIL								
BRITISH EMPIRE								
Trinidad:								
Production	Long ton	49,835	44,839	48,345	58,507	58,140	56,965	626,644
Exports:								
Crude petroleum . .	Gallon	2,110,661		2,000	2,464	550,277	5,764	10,372,810
Gasoline	do.	192,203		2,442,963	469,923	2,080,357	311,968	13,348,862
Kerosene	do.	68,500		1,408,571	79,460	40,359	95,381	2,917,810
Fuel-oil	do.	8,142,386		7,537,061	10,442,097	12,783,251	11,898,863	85,253,840
Lubricating oil . . .	do.	2,030		1,479	926	1,162	93	31,535
India:								
Exports overseas:								
Benzine and other light oils.	Gallon	2,323,236	—	344	—	—	2,560,000	12,822,072
Other mineral oils . .	do.	7,707	9,876	10,738	11,909	7,066	13,748	137,242
FOREIGN COUNTRIES								
France:								
Production	Long ton	4,974	5,799	5,634	5,365	3,614	5,047	67,753
Italy:								
Production	Long ton							5,067
Poland:								
Production	Long ton	63,300	69,700	66,086	67,703	67,800	67,800	798,862
Rumania:								
Total production . . .	Long ton	193,362	195,974	212,359	232,699	200,280	194,368	2,274,535
By fields:								
Prahova	do.	158,681	154,627	171,637	187,029	155,147	150,820	1,821,962
Dambovitza . . .	do.	21,778	27,366	25,525	29,724	31,391	30,175	291,808
Other fields . . .	do.	12,903	13,981	15,197	15,946	13,742	13,373	160,765
Russia:								
Total production . . .	Long ton	614,000	613,000	651,000	647,000	629,000	646,000	7,489,000
Of which, Baku . . .	do.	416,000	483,200	460,000	434,830	442,578	429,810	4,900,000
Algeria:								
Production	Long ton	750	164	151	159	159	149	1,791

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Mexico:								
Production (*a*)	Long ton	1,211,660	1,177,742	1,078,586	1,144,066	1,230,092		16,581,052
United States (*a*) (*c*):								
Total production	Long ton	9,616,900	9,538,400	9,244,000	9,193,100	8,779,900	8,706,100	107,978,900
By fields:								
Appalachian	do.	341,300	328,400	330,300	334,900	307,600	320,100	3,895,800
Lima-Indiana	do.	27,600	26,000	25,600	24,700	21,700	22,400	303,000
Illinois-S.W. Indiana	do.	107,000	99,400	103,000	104,400	98,200	98,400	1,214,700
Mid-Continent	do.	5,366,400	5,236,700	5,070,600	5,010,100	4,812,100	4,719,700	60,138,000
Gulf Coast	do.	425,700	394,400	392,600	395,300	363,400	362,200	4,494,000
Rocky Mountain	do.	433,100	452,600	455,800	464,400	448,900	433,300	5,055,100
California	do.	2,915,800	3,000,900	2,866,100	2,859,300	2,728,000	2,750,000	32,878,300
By class:								
Light crude (24° (0·910) and lighter)	do.	6,542,300	6,525,800	6,453,100	6,474,700	6,226,600	6,138,000	77,169,700
Heavy crude (heavier than 24° A.P.I.)	do.	3,074,600	3,012,600	2,790,900	2,718,400	2,553,300	2,568,100	30,809,200
Argentina:								
Production	Long ton							930,515
Colombia:								
Production	Long ton							70,000
Peru:								
Production	Long ton							1,600,000
Venezuela:								
Production	Long ton	(*b*)159,240	(*b*)224,300	(*b*)219,600	(*b*)322,500	342,100	377,400	2,987,514
Japan:								
Production	Long ton							237,000
PHOSPHATES								
BRITISH EMPIRE								
United Kingdom:								
Total imports of phosphate-rock and phosphate of lime.	Long ton	22,166	27,492	22,920	15,934	56,206	32,165	333,179
Exports of superphosphates	do.	864	2,861	1,515	337	55	585	18,671

Canada:								
Imports of phosphate-rock .	Long ton	3,744	27	3,769	—	36	—	12,502
Imports of superphosphates .	do.	2,454	2,225	8,579	1,514	4,007	6,090	56,700
Ceylon:								
Imports of superphosphates .	Long ton	—	396	174	321	465	675	3,761
New Zealand:								
Total imports of phosphate-rock, superphosphates and other fertilisers . . .	Long ton	4,608	18,894	16,991	4,999	5,960	12,578	174,994
Foreign Countries								
Denmark:								
Total imports of phosphate-rock	Long ton	11,957	21,544	12,148	5,229	11,872	10,557	124,794
Total imports of superphosphates	do.	1,195	13,418	13,740	1,831	441	11,452	144,975
France:								
Imports of phosphate-rock .	Long ton	113,137	117,547	109,537	90,338	112,491	124,319	1,274,892
Imports of superphosphates .	do.	688	1,363	2,741	1,078	409	537	21,927
Exports of superphosphates .	do.	7,424	22,731	34,075	34,625	22,893	26,741	225,676
Germany:								
Imports of phosphate-rock .	Long ton	22,832	46,119	36,200	22,858	18,413	39,848	392,954
Imports of superphosphates .	do.	1,677	4,410	6,706	3,734	371	444	39,327
Exports of superphosphates .	do.	3,515	4,532	6,199	3,053	837	3,633	45,007
Italy:								
Imports of phosphate-rock .	Long ton	63,097	103,570	65,053	57,155	66,883	73,722	823,292
Norway:								
Total imports of superphosphates	Long ton	1,272	20	30	106	585	300	21,665
Sweden:								
Imports of phosphate-rock .	Long ton	18,249	21,776	4,384	33,007	—	—	144,074
Exports of superphosphates .	do.	12,925	12,824	1,717	2,315	2,374	4,624	87,200
Algeria:								
Production of phosphate-rock	Long ton	51,763	55,177	53,653	54,134	60,352	59,909	705,114

(*a*) *Converted at rate of 7 barrels = 1 long ton.* (*b*) *Shipments.*
(*c*) *Figures refer to petroleum transported from fields. Production, which would include fuel consumed and stocked, was approximately* 109,000,000 *long tons for the year.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Egypt:								
Exports of phosphate-rock	Long ton	—	8,610	10,922	—	—	—	65,292
Total imports of superphosphates	do.	—	532	9,876	13,838	15,898	7,881	54,906
Morocco:								
Sales of phosphates	Long ton							709,106
Tunis:								
Production of phosphate-rock	Long ton	195,801	208,000	210,561	247,790	189,000	211,000	2,648,000
United States:								
Exports of phosphate-rock	Long ton	97,722	73,734	77,252	71,850	44,286	98,872	870,276
Exports of superphosphates	do.	696	4,678	9,500	2,772	1,908	4,108	66,879
Japan:								
Total imports of phosphate-rock	Long ton	22,681	26,530	27,923	11,774	37,094		
PLATINUM								
BRITISH EMPIRE								
Union of South Africa (Transvaal):								
Sales and shipments of osmiridium	Troy oz.	288	538	1,293	515	576	279	6,055
Canada (Ontario):								
Production of platinum metals	Troy oz.	(*a*)2,659	(*a*)2,659	(*a*)2,659	(*b*)2,728	(*b*)2,728	(*b*)2,728	16,980
Canada:								
Platinum content of exports of concentrates, etc.	Troy oz.	—	72	30	1	39	45	404
Scrap	do.	328	26	45	31	42	36	655*
Australia:								
Victoria: Exports of osmiridium overseas	Troy oz.	45	89	93	417	456	547	2,004
Tasmania: Production of osmiridium	do.	(*a*)236	(*a*)236	(*a*)236	(*b*)786	(*b*)786	(*b*)786	3,366

FOREIGN COUNTRIES								
United States:								
Production from placers .	Troy oz.							343
Exports of unwrought platinum	do.	1,145	1,232	1,071	1,326	1,592	1,337	16,234
Imports of unwrought platinum	do.	9,201	8,939	9,723	11,195	7,641	11,832	106,478
Imports of iridium, osmium, palladium, etc. . . .	do.	1,626	1,366	1,711	1,573	1,857	1,845	14,931
POTASH								
BRITISH EMPIRE								
India:								
Exports overseas of nitrate of potash	Long ton	438	520	330	403	363	676	6,349
FOREIGN COUNTRIES								
France:								
Total production of potash in terms of K_2O . . .	Long ton	24,481	23,740	25,634	28,793	29,078	30,298	305,183
Production by grades, gross weight:								
Crude, 12-16 per cent. K_2O.	do.	30,906	18,837	24,469	29,511	32,301	32,549	348,117
Manure, 20-22 per cent. K_2O	do.	34,173	49,092	47,647	49,059	57,316	47,423	479,935
Manure, 30-40 per cent. K_2O	do.	20,484	8,388	12,261	11,455	4,545	15,553	157,180
Chloride, more than 50 per cent. K_2O . . .	do.	9,322	11,387	14,184	18,816	19,035	18,461	178,666
Exports of:								
Kainite and sulphate of magnesia and potash . .	do.	485	1,082	3,050	5,820	4,070	883	30,612
Carnallite, sylvinite, etc. .	do.	71,981	59,495	38,601	41,596	64,214	82,768	655,752
Other chloride of potash .	do.	2,390	14,262	6,138	865	1,966	3,624	42,323
Natural nitrate of potash .	do.	371	161	868	164	577	204	3,654
Synthetic nitrate of potash .	do.	713	716	89	478	214	224	2,604
Germany:								
Sales of K_2O by the Kalisyndikat	Long ton	94,064	102,759	99,570	72,355	56,679	57,974	1,205,759

(a) *Monthly average of third quarter,* 1925.

(b) *Monthly average of fourth quarter,* 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Germany (*continued*):								
Exports of:								
Potash and other waste salts	Long ton	89,830	160,473	96,836	67,335	96,119	88,204	1,127,608
Nitrate of potash . .	do.	1,480	1,860	998	1,212	1,301	1,062	16,029
Chloride of potash . .	do.	15,881	20,950	13,975	8,917	16,048	16,651	193,512
Sulphate of potash . .	do.	5,160	11,293	15,726	7,231	10,414	13,379	127,290
Sulphate of magnesia and potash	do.	339	2,769	4,077	1,803	2,371	3,838	39,587
Potash, including wool yolk ash	do.	996	686	1,255	1,038	1,281	1,132	12,017
Italy:								
Production of leucite . .	Long ton							4,700
Production of alunite . .	do.							1,600
PYRITES								
British Empire								
United Kingdom:								
Production in Great Britain, including arsenical pyrites .	Long ton	(b)436	(b)436	(b)436				
Total imports, including cupreous pyrites	do.	24,189	25,834	19,138	18,362	17,074	29,880	275,322
Union of South Africa (Transvaal):								
Sales and shipments . .	Long ton	173	178	195	196	150	148	2,472
Foreign Countries								
Austria:								
Production in Styria . .	Long ton	984	956	1,010	1,069	859	966	10,843
France:								
Production	Long ton	16,029	17,264	18,463	17,209	15,795	14,665	194,736
Imports	do.	32,613	36,428	22,070	35,097	33,667	67,211	477,363
Germany:								
Imports of pyrites and other sulphur minerals . .	Long ton	59,687	44,410	46,178	80,015	87,969	96,910	917,630
Exports of pyrites and other sulphur minerals . .	do.	389	661	2,228	637	342	1,034	11,469

Italy:								
Production of iron pyrites .	Long ton							504,900
Imports of iron pyrites . .	do.	17,939	20,773	12,022	12,994	26,741	2,781	193,165
Exports of iron pyrites . .	do.	19,123	15,430	17,709	13,411	16,047	11,153	170,762
Exports of cupreous pyrites .	do.	—	—	1,223	12	—	—	4,271
Norway:								
Exports of iron pyrites . .	Long ton	8,746	9,323	7,366	18,086	6,641	11,002	94,135
Exports of cupreous pyrites .	do.	33,003	42,026	44,183	51,345	42,372	21,789	433,678
Algeria:								
Production of iron pyrites .	Long ton	696	844	1,151	1,026	994	987	12,373
United States:								
Production of iron pyrites .	Long ton							170,081
Total imports (containing more than 25 per cent. of sulphur)	Long ton	31,049	19,455	23,844	7,700	26,458	6,228	276,385
QUICKSILVER								
Austria (Tyrol):								
Production	Lb.	1,100	1,100	1,100	1,100	1,100	1,100	13,200
Italy:								
Production	Lb.							3,636,600
Exports	do.	193,291	155,162	158,688	323,327	432,866	368,950	3,322,310
Mexico:								
Production	Lb.	4,386	4,756	7,870	3,584	4,302	14,913	85,331
SILVER								
PRODUCTION IN BRITISH EMPIRE								
Northern Rhodesia . . .	Fine troy oz.	34	(a)4,879	218	—	27	—	(a)5,267
Southern Rhodesia . . .	Fine troy oz.	13,920	15,368	12,077	10,360	9,904	9,144	152,705
Union of South Africa (Transvaal):								
Sales and shipments in gold bullion	Fine troy oz.	82,695	79,881	77,480	78,091	78,041	75,374	934,254
Sales and shipments in other minerals	do.	18,108	24,971	12,095	22,430	—	—	225,815

(*a*) *Including an adjustment for the period* 1920–1924 *inclusive.*   (*b*) *Monthly average of third quarter,* 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Canada :								
Production in Ontario . .	Fine troy oz.	(a)770,608	(a)770,608	(a)770,608	(e)767,870	(e)767,870	(e)767,870	(b)10,217,315
Silver content of ore, concentrates, etc., exported . .	do.	419,824	756,093	596,322	422,070	263,395	367,639	4,754,915
Silver bullion exported . .	Troy oz.	748,659	1,044,132	1,186,958	838,804	1,236,122	2,021,989	14,316,797
India (Burma) . . .	Fine troy oz.	390,011	418,000	416,000	410,832	422,000	478,000	4,670,000
Australia :								
Queensland	Fine troy oz.	(a)21,156	(a)21,156	(a)21,156	(e)26,623	(e)26,623	(e)26,623	286,516
Western Australia(c) . .	do.	—	19,810	82	—	21,454	692	81,221
Tasmania	do.	(a)69,780	(a)69,780	(a)69,780	(e)66,806	(e)66,806	(e)66,806	730,194
New Zealand :								
Exports of silver . . .	Troy oz.	36,955	18,713	46,387	46,211	38,242	31,251	495,268
PRODUCTION IN FOREIGN COUNTRIES								
Italy :								
Refinery production . .	Troy oz.							268,800
Cuba :								
Production	Fine troy oz.							91,916
Mexico	Fine troy oz.	7,732,107	6,900,258	7,606,465	8,417,577	8,027,180	9,721,356	92,885,176
United States	Fine troy oz.	5,365,000	4,934,000	4,845,000	4,933,000	4,898,000	4,931,000	65,722,720
Bolivia :								
Quantity of ore exported .	Cwt.	22,688	14,424	22,735	14,601	18,582	22,646	223,214
Value of ore exported . .	£	54,620	41,151	45,877	55,554	50,142	56,313	577,085
Chile :								
Exports of ore . . .	Cwt.	2,194	840	4,264	3,434	728	1,411	15,023
Exports of silver bullion .	Troy oz.	13,798	16,097	34,015	11,233	25,331	37,082	300,828
Ecuador :								
Production	Fine troy oz.							78,000
Peru :								
Production	Fine troy oz.							20,888,400
Exports of :								
Ore (d)	Cwt.	993	439	673	590	1,397	2,327	14,576
Concentrates (d). . .	do.	12,507	15,053	19,341	—	13,134	10,812	104,179

Sulphides (*d*) . . .	do.	74	96	87	76	82	77	888
Silver bullion . . .	Troy oz.	22,248	22,859	21,894	260,383	210,840	186,792	790,922
Silver scrap . . .	do.	—	161	675	—	—	675	2,122
Japan :								
Production	Fine troy oz.							5,665,000
SULPHUR								
BRITISH EMPIRE								
United Kingdom :								
Total imports . . .	Long ton	14,605	9,299	7,929	6,306	7,260	7,793	109,795
Canada :								
Imports	Long ton	13,717	17,694	6,104	25,958	22,362	4,566	130,902
India :								
Total imports from overseas .	Long ton	970	340	659	546	1,314	1,335	12,337
New Zealand :								
Total imports . . .	Long ton	968	3,383	1,808	13	1,678	3	19,982
FOREIGN COUNTRIES								
Finland :								
Total imports . . .	Long ton	3,014	6,335	4,052	6,552	5,944	1,680	31,924
France :								
Imports of crude sulphur .	Long ton	30,296	26,349	16,705	28,870	26,245	52,103	446,326
Exports of crude sulphur .	do.	2,573	496	1,371	2,473	1,396	1,382	13,820
Exports of refined sulphur .	do.	1,067	256	550	613	588	438	16,523
Germany :								
Imports	Long ton	3,749	3,945	22,922	3,827	8,119	13,797	103,817
Exports	do.	3,572	3,288	254	16,944	5,119	2,846	56,818
Italy :								
Production of crude sulphur .	Long ton							259,000
Production of ground sulphur.	do.							22,000

(*a*) *Monthly average of third quarter,* 1925. (*b*) *Silver content of ore produced in the Dominion was* 20,003,970 *fine troy ounces.*
(*c*) *Silver content of bars, slag, etc., exported from the State, not necessarily overseas.*
(*d*) *Silver is also contained in ores of base metals exported.* (*e*) *Monthly average of fourth quarter,* 1925.

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Italy (*continued*):								
Exports of crude lump sulphur	Long ton.	7,976	1,687	12,306	6,965	5,475	4,789	94,323
Exports of crude ground sulphur	do.	106	68	62	166	315		18,462
Exports of refined lump sulphur	do.	2,715	2,078	2,683	97	1,317	3,535	33,735
Exports of refined ground sulphur	do.	1,492	1,535	230	469	490	451	32,525
Exports of flowers of sulphur .	do.	263	101	88	239	618	112	8,132
Norway:								
Total imports	Long ton	1,949	2,894	1,300	1,002	1,209	1,211	15,292
Sweden:								
Imports	Long ton	6,121	6,280	8,383	8,637	7,630	6,112	62,184
United States:								
Production	Long ton							1,409,240
Exports of sulphur . .	do.	82,791	45,586	63,845	64,655	36,651	58,176	629,401
Exports of flowers of sulphur .	do.	130	117	181	276	204	271	2,849
Japan:								
Production of sulphur rock .	Long ton							46,000
TIN								
BRITISH EMPIRE								
United Kingdom:								
Tin content of ore produced .	Long ton	(*d*)197	(*d*)197	(*d*)197	(*b*)155	(*b*)155	(*b*)155	2,105
Total imports of ores and concentrates	do.	6,108	6,694	3,867	5,866	4,793	5,196	64,138
Re-exports of ores and concentrates	do.	30	27	10	17	1	10	256
Exports of blocks, ingots, etc.	do.	1,856	2,753	2,882	2,240	2,267	2,485	25,730
Total imports of blocks, ingots, etc.	do.	1,641	794	953	1,183	1,113	2,577	15,934
Re-exports of blocks, ingots, etc.	do.	1,458	776	293	541	467	1,579	9,508
Nigeria:								
Approximate tin content of ore produced . . .	Long ton	480	600	650	662	706	674	6,377

Southern Rhodesia:								
Tin content of ore produced	Long ton	—	5	—	—	—	7	17
South-West Africa Territory:								
Exports of ore	Long ton	31	17	18	13	24		
Union of South Africa (Transvaal):								
Tin content of marketable products	Long ton	94	97	106	101	101	109	[illegible]37
Federated Malay States:								
Total tin content of exports	Long ton	4,242	3,715	3,988	3,872	3,543	3,524	45,925
By class:								
Tin in ore	do.	3,553	3,063	3,348	3,288	2,996	2,947	38,567
Tin	do.	689	652	640	584	547	577	7,358
By state:								
Perak	do.	2,715	2,442	2,678	2,521	2,414	2,342	30,748
Selangor	do.	1,347	1,098	1,151	1,199	954	983	13,104
Negri Sembilan	do.	(c)	1	1	—	—	—	3
Pahang	do.	180	174	158	152	175	199	2,070
India:								
Tin content of ore produced	Long ton							1,300
Exports overseas of tin ore	do.	160	113	239	174	203	154	1,887
Exports overseas of tin	do.	—	3	50	50	—	100	353
Australia:								
Tin content of ore produced in:								
Queensland:								
Lode tin	Long ton	(d)65	(d)65	(d)65	(b)88	(b)88	(b)88	674
Alluvial tin	do.	(d)34	(d)34	(d)34	(b)24	(b)24	(b)24	335
Tasmania	do.	(d)96	(d)96	(d)96	(b)125	(b)125	(b)125	1,130
Western Australia (a)	£	—	30	3,005	3,190	520	1,315	15,392
Exports overseas of refined tin from:								
New South Wales	Long ton	101	141	200	186	176	193	1,560
Victoria	do.	25	20	25	25	23	35	188
Exports overseas of tin clippings from:								
New South Wales	do.	10	460	150	—	97	208	1,036

(a) *Value of exports from the State, not necessarily overseas.*
(b) *Monthly average of fourth quarter, 1925.*
(c) *Less than ½ ton.*
(d) *Monthly average of third quarter, 1925.*

Particulars.	Unit.	July 192_.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Australia: Exports overseas of tin clippings from (*continued*):								
Victoria	Long ton	—	683	286	163	47	605	2,264
Queensland . . .	do.	114	53	—	—	175	7	349
South Australia . .	do.	—	28	—	—	—	—	28
FOREIGN COUNTRIES								
France:								
Production of tin-tungsten ore	Long ton	—	—	—	590	472	594	1,658
Germany:								
Imports of ore . . .	Long ton	141	57	77	221	16	83	1,677
Imports of crude tin and scrap	do.	949	914	1,085	962	984	652	12,736
Exports of crude tin and scrap	do.	341	265	254	270	294	266	2,724
Exports of tin-foil. . .	do.	23	15	19	23	24	22	257
Belgian Congo:								
Production of cassiterite .	Long ton							1,500
United States:								
Imports of bar, block or pig tin	Long ton	6,735	7,747	5,365	6,401	4,574	7,449	76,646
Re-exports of bar, block or pig tin	do.	28	43	85	63	40	33	570
Exports of bar, block or pig tin	do.	61	41	11	35	72	23	362
Bolivia:								
Tin content of shipments to Europe and the United States	Long ton	2,653	2,643	1,565	1,493	4,285	1,952	30,240
China:								
Tin content of shipments (*a*) .	Long ton	118	639	370	(*f*)250	(*g*)302	(*h*)889	7,421
Dutch East Indies:								
Tin content of ore produced .	Long ton							32,749
Shipments of Banca tin (*a*) .	do.	1,501	881	1,521	252	1,273	1,624	14,177
French Indo-China:								
Exports of tin-tungsten ore .	Long ton	52	26	32	61	40		460
Exports of tin ingots . .	do.	35	(*b*)	22	46	10		300
Siam:								
Tin content of ore produced .	Long ton	655	706	695				7,900

ZINC								
British Empire								
United Kingdom:								
Zinc content of ore produced	Long ton	(d)57	(d)57	(d)57				
Smelter output	do.							(e)41,636
Exports of spelter and wrought zinc, etc.	do.	381	702	354	413	341	420	5,393
Total imports of spelter	do.	14,817	10,184	9,704	10,481	13,628	13,028	135,780
Total imports of wrought zinc, etc.	do.	1,896	1,300	1,341	1,341	1,873	1,948	18,383
Re-exports of spelter	do.	646	871	204	75	178	1,179	7,686
Northern Rhodesia:								
Smelter output	Long ton	16	13	22	14	10	14	148
Canada:								
Zinc content of ore produced	Long ton							49,407
Exports of ore	do.	6,221	4,694	5,034	2,378	2,275	3,730	43,161
Smelter output	do.	2,518	3,268	3,593	3,484	3,748	3,720	34,358
Exports of spelter	do.	1,875	1,200	1,537	2,541	2,815	2,791	22,244
India:								
Production of concentrates in Burma	Long ton	(d)1,423	(d)1,423	(d)1,423	1,808	1,809	1,826	16,600
Exports overseas of spelter, etc.	do.	1,530	19	2,033	13	4,009	10	20,967
Total imports from overseas of spelter, etc.	do.	603	522	605	579	561	586	6,606
Australia:								
Zinc content of ore produced in:								
Queensland	Long ton	(d)23	(d)23	(d)23	—	—	—	171
Tasmania	do.	(d)125	(d)125	(d)125	(i)212	(i)212	(i)212	3,113
Exports overseas of ore, etc., from:								
Queensland (ore)	Long ton	—	167	—	—	38	—	462
South Australia (concentrates)	do.	23,943	(c)35,631	5,647	14,005	16,128	32,734	181,844

(a) *From 26th of previous month to 25th of month stated.* (b) *Less than ½ ton.* (c) *Including 2,106 long tons of "middlings."* (d) *Monthly average of third quarter, 1925.* (e) *Excluding output of one maker.* (f) *Approximate.* (g) *To United Kingdom and United States.* (h) *To United Kingdom, Europe and United States.* (i) *Monthly average of fourth quarter, 1925.*

Particulars.	Unit.	July 1925.	August 1925.	September 1925.	October 1925.	November 1925.	December 1925.	Year 1925.
Australia (*continued*) :								
Smelter output in :								
Tasmania	Long ton	(*a*)3,745	(*a*)3,745	(*a*)3,745	(*b*)3,656	(*b*)3,656	(*b*)3,656	42,976
Commonwealth . . .	do.	3,961	3,937	3,810	3,937	3,810	3,923	45,561
Exports overseas of spelter from :								
New South Wales . .	Long ton	302	1	502	1	1	801	2,864
Tasmania	do.	2,450	1,150	2,150	3,660	—	1,100	24,361
FOREIGN COUNTRIES								
Austria (Carinthia) :								
Production of ore . . .	Long ton	99	53	49	40	379	202	1,402
Belgium :								
Smelter output . . .	Long ton	13,080	12,780	13,140	14,690	14,926	15,605	169,127
France :								
Production of ore . . .	Long ton	906	851	751	1,082	1,293	3,965	14,528
Imports of ore . . .	do.	9,576	7,902	11,960	15,577	7,612	11,937	167,718
Exports of ore . . .	do.	565	2,359	1,731	1,405	1,466	4,128	23,034
Imports of spelter, sheets and scrap	do.	4,348	4,041	3,576	3,253	3,703	4,148	45,628
Exports of spelter, sheets and scrap	do.	2,759	1,766	2,075	1,692	1,302	1,079	19,412
Germany :								
Production of ore . . .	Long ton			4,603				
Imports of ore . . .	do.	8,258	7,096	7,567	8,043	3,287	9,076	90,903
Exports of ore . . .	do.	5,629	6,226	7,278	6,101	8,198	6,859	72,443
Smelter output . . .	do.	4,801	4,643	4,529	4,614	4,613	4,699	57,705
Imports of spelter, dust, sheets, wire and scrap . . .	do.	11,015	9,746	9,812	8,397	10,805	5,400	133,560
Exports of spelter, dust, sheets, wire and scrap . . .	do.	2,145	2,034	2,908	3,176	4,616	4,776	26,662
Italy :								
Production of ore . . .	Long ton							161,197
Exports of ore . . .	do.	12,494	9,807	2,228	3,596	22,026	7,928	171,578

Smelter production . .	do.							6,277
Imports of spelter, sheets, plates and scrap . .	do.	2,235	1,620	1,869	1,811	1,449	1,812	18,140
Upper Silesia:								
Production of ore . . .	Long ton	29,332	27,620	27,510	29,675	30,688	24,623	313,576
Smelter output . . .	do.	7,679	7,900	7,968	9,300	8,265	8,209	89,487
Algeria:								
Production of ore . . .	Long ton	4,381	4,867	3,616	3,345	1,120	4,285	47,391
Tunis:								
Production of ore . . .	Long ton	2,112	1,244	2,578	1,672	1,969	1,515	19,196
Mexico:								
Zinc content of ore produced .	Long ton	4,158	3,223	4,093	5,072	4,291	14,381	45,034
Smelter output . . .	do.	—	89	121	285	359	401	1,255
United States:								
Zinc content of ore produced .	Long ton							636,000
Shipments of Joplin ore .	do.	39,758	67,082	62,546	72,569	65,996	59,356	726,074
Total imports of ore . .	do.	99	1,532	142	3,455	184	1,545	12,086
Exports of ore and dross .	do.	8,186	10,754	13,726	14,933	14,018	6,384	75,874
Smelter output . . .	do.	42,485	42,722	42,307	45,087	45,205	48,030	527,614
Exports of spelter, dust, sheets, etc. . . .	do.	8,770	4,980	4,459	6,624	3,665	2,690	73,919
Bolivia:								
Exports of ore . . .	Long ton	395	477	701	366	1,346	1,902	6,110
French Indo-China:								
Exports of ore . . .	Long ton	1,965	8,267	1,031	9,598	2,842		50,000
Japan:								
Total imports of ore . .	Long ton	2,908	1,237	(c)	3,007	—		
Total imports of spelter, sheets, etc.	do.	840	2,163	2,345	3,630	3,586		

(a) *Monthly average of third quarter,* 1925. (b) *Monthly average of fourth quarter,* 1925. (c) *One cwt.*

SECTION A—PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial, and Indian Governments

---

TOBACCO FROM PALESTINE, NIGERIA AND MAURITIUS.

In connection with the attempts that have been or are being made in many countries of the Empire to produce tobacco that will find a market in this country, a large number of samples have been received and examined at the Imperial Institute in order to ascertain their suitability for British requirements. Advice has also been given to growers as to methods of cultivation and preparation, and as to the most suitable varieties to grow under the varying conditions obtaining in the different countries. The results of the investigation of many of the samples have already been published in this BULLETIN ; and in the present article, tobaccos from Palestine, Nigeria and Mauritius are dealt with. Those received from Palestine were of Turkish varieties and, as explained later, tobacco of good quality is already being exported from that country. The pipe tobaccos from Nigeria were of promising character, but owing to certain economic considerations, the attempts made by the Agricultural Department to induce the natives to grow tobacco for export have been discontinued for the present. The tobaccos received from Mauritius were of the cigar filler type, and as it was the first attempt to produce that kind of tobacco in the island and experience in curing was lacking, the results cannot be taken as conclusive.

In addition to the countries mentioned, samples of tobacco have also been received recently from Dominica and Tanganyika Territory. That from the former colony was a dark

leaf suitable only for the preparation of pipe tobacco, for which purpose it was valued by brokers at about 1*s*. 6*d*. per lb. in London. Five samples of tobacco of Turkish type were forwarded from Tanganyika. Although not of very good quality, and suitable only for blending with the lower grades of Turkish tobacco for the manufacture of cigarettes, they were nevertheless of promising character, and with more experience in methods of curing and fermentation it seems likely that Turkish tobacco of good quality could eventually be produced in the Territory.

Palestine.

Considerable attention has been paid during the last few years to the cultivation of tobacco in Palestine. The climate is well suited to the crop and the soil in many regions is also suitable. Under the Turks, the cultivation was vested in a monopoly granted to the Régie Co-Interessée des Tabacs de l'Empire Ottoman, who also controlled the manufacture and sale. Cultivation was prohibited except in a few villages in the Kaza of Acre. During the war, however, the prohibition was removed in Northern Palestine, where considerable quantities were produced for the use of the Ottoman troops. The monopoly was abolished by the Palestine Government in January 1921, and since that time the areas planted have increased year by year. Experiments conducted by private enterprise, assisted by the Agricultural Department, showed that the production of tobacco of excellent quality was possible, and in 1924 a wave of enthusiasm for tobacco cultivation passed over the country. Thousands of acres were devoted to the crop, both in Arab and Jewish villages, and the production far exceeded the local demand. Much of the leaf, however, owing to the inexperience of many of the growers, was of inferior quality, and it became necessary for the authorities to call attention to the importance of concentrating on the quality, rather than the quantity, of leaf produced. A considerable proportion of the surplus nevertheless found a ready market abroad, 83,900 lb. being shipped to Germany during February and March 1925. The total exports in 1924 and 1925 were 3,020 lb. and 95,090 lb. respectively, the United Kingdom taking 3,515 lb. in the latter year.

The bulk of the crop consists of Turkish varieties, including Macedonian, Anatolian, Kavalla, Seres and Samsuni. The last-named kind produces the best leaf and is the variety specially recommended for cultivation in Palestine. In 1924 it was estimated that nearly 4,000 acres were planted with Turkish varieties, and about 700 acres with the native variety (" Baladi "). The crop in that year was estimated to be 1,200 tons of Turkish and 540 tons of Baladi; the local consumption is about 300 tons of each kind.

With a view to encouraging the cultivation of tobacco and assisting growers, a Co-operative Society of Arab Tobacco Growers and another of Jewish Tobacco Growers have been formed. An Ordinance regulating the taxation, cultivation, manufacture, etc., of tobacco came into force on 1st May 1925.

On the removal of the monopoly in 1921, the manufacture of cigarettes in Palestine became possible and there are now twenty or more factories, employing a large number of hands. At first, imported Turkish tobacco was employed in the factories, but the quantity of locally grown leaf used is increasing. The raising of the customs duty on imported cigarettes from P.T. 60 to P.T. 100 per kilo. in June 1925, should still further encourage the manufacture of cigarettes in the country.

Sir Herbert Samuel in his Report on the Administration of Palestine, 1920–1925, considers that the good quality of a large part of the crop, and the remunerative prices obtained, indicate that tobacco may become one of the chief sources of the agricultural wealth of Palestine. It is already an important source of revenue, the amount derived in excise and customs, in 1924–25, being estimated at £E.100,000.

In order to ascertain the relative suitability of the different varieties grown in Palestine for the British market, samples were forwarded to the Imperial Institute in 1924 and 1925. The results of their examination are given below.

Series I.

The samples received in 1924 included seven leaf tobaccos and one of Latakia which consisted of the entire plant.

The general characteristics of the seven leaf tobaccos are given in the following table :—

Sample.	Size of Leaves. *Inches.*	Colour of Leaves.	Texture of Leaves.
No. 1. Anatolian, from Mikveh Israel	4½–9½ long, 1¾–4 wide	Light sandy brown to light orange-brown	Fair.
No. 2. Anatolian-Macedonian Hybrid, from Mount Carmel	4–10 long, 1½–4½ wide	Dark orange-brown, some showing greenness	Inclined to be harsh and weak; on the whole, of fair texture.
No. 3. Macedonian (second crop), from Rosh Pina	3½–6 long, 2–3 wide	Light sandy yellow	Of fair texture and appearance.
No. 4. Anatolian-Macedonian Hybrid, from Damann	5½–8 long, 2½–4 wide	Mostly dark orange-brown, a few light sandy yellow	Texture on the whole fair, some leaves rather harsh and brittle.
No. 6. Anatolian, from Malia	5½–9 long, 2–4 wide	Light orange	On the whole rather weak and papery.
No. 7. Anatolian, from Tershiha	5½–10 long, 2½–6 wide	Yellow to orange-brown	Of fair texture, some leaves inclined to be papery.
No. 8. Anatolian, from Ras-el-Ahmar	6 – 9 long, 3 – 4 wide, mostly 9 by 4	Light brown to yellowish-brown. Slightly dirty	Some of fair texture; on the whole, inclined to be weak and papery; of poor appearance.

It was stated that all these samples represented the 1923 crop, with the exception of one-third of sample No. 3, which was drawn from the 1922 crop.

The sample of Latakia (No. 5) was described as "Latakia Pipe Leaf from Wadi Sherour. Crop grown in 1918." This sample consisted of the whole plant, including thick stems and ripe fruits, and was cut into lengths of from 4 to 6 in. Some of the stems measured up to 0·4 in. in diameter. The material was of a dark brown to blackish tint and possessed the characteristic odour of Latakia tobacco.

The amounts of nitrogen in the samples (except No. 5) were found to be as follows :—

Sample No.	Nitrogen (in leaves containing 14 per cent. moisture). *Per cent.*
1	2·14
2	2·53
3	2·09
4	2·41
6	2·22
7	1·90
8	1·81

Sample No. 2 was selected, as fairly representative of the seven leaf tobaccos and was analysed with the following results, which are calculated on a basis of 14 per cent. of moisture :—

	Per cent.
Moisture	14·0
Nicotine	1·75
Nitrogen	2·53
Ash	16·4

The results of analysis of the ash were as follows :—

		Per cent.	Calculated on CO_2-free ash. Per cent.
Lime	CaO	40·16	53·60
Magnesia	MgO	5·76	7·69
Potash	K_2O	14·73	19·66
Soda	Na_2O	2·07	2·76
Sulphates, expressed as sulphuric anhydride	SO_3	3·55	4·74
Chlorides, expressed as chlorine	Cl	3·43	4·58
Carbonates, expressed as carbon dioxide	CO_2	25·10	—

These results show the leaf to contain satisfactorily low percentages of nicotine and nitrogen, but the amounts of sulphates and chlorides in the ash are slightly high.

The samples, with the exception of No. 5 (Latakia), were submitted to smoking trials with the results given below :—

Sample.	Result of Trial.
No. 1	Good flavour ; satisfactory burning qualities ; white to grey ash.
No. 2	Holds fire fairly well, leaving a white to grey ash ; fairly good flavour, but rather too strong and pungent for a good Turkish grade.
No. 3	Burning qualities satisfactory ; grey ash ; flavour good, though a trifle pungent, and slightly inferior to that of No. 1.
No. 4	Grey ash ; flavour, etc., similar to No.2.
No. 6	Grey ash ; fairly good flavour, though rather strong and pungent for Turkish tobacco.
No. 7	White to grey ash ; strong flavour ; pungent.
No. 8	Grey ash ; strong flavour ; more pungent than No. 7.

It will be observed that in general the seven samples possessed satisfactory burning qualities, but on the whole their flavour was rather strong and pungent for Turkish leaf.

Samples Nos. 6 and 8 were too small for commercial valuation, but Nos. 1, 2, 3, 4 and 7 were submitted to manufacturers specialising in Turkish tobacco, who reported that the products were lacking in character and aroma and were somewhat harsh, but that they burnt well and should be saleable in the United Kingdom at 1*s.* 3*d.* to 1*s.* 6*d.* per lb. (May 1924), as medium grade leaf for use in the manufacture of the cheapest grades of Turkish cigarettes.

The Latakia tobacco, No. 5, grown in 1918, was submitted to another firm of manufacturers, who reported that it was insufficiently fumigated, but that if it was five years since it was fumigated it would not be quite fair to express a definite opinion on it.

General Remarks.—The burning properties of the seven samples (Nos. 1, 2, 3, 4, 6, 7 and 8) were satisfactory, Nos. 1 and 3 being the best in this respect. The ash of sample No. 2, which was fully analysed, was found to contain sufficient potash, but the total amount of sulphates and chlorides present, although not excessive, approached the maximum compatible with good burning quality. The best samples were Nos. 1 and 3, which had a fairly good flavour; the next best were Nos. 2, 4 and 6, whilst Nos. 7 and 8 were the least attractive, being rather strong and pungent for Turkish leaf.

The amounts of nitrogen in the tobaccos were not excessive, but they indicate that in all cases there was a sufficiency of nitrogenous matter in the soil.

With the exception of samples Nos. 1 and 3 the colour of much of the tobacco was dark, and the leaves were rather large. The preparation of the leaf might be improved by curing to a yellow tint and avoiding the dark orange-brown colour shown by the larger leaves of the present samples.

Series II.

The samples in this series were stated to represent bulk quantities of the 1924–25 crop; to consist of a mixture of several grades and varieties; and to be unfermented.

The samples consisted of two sets: I, from the northern villages, and II, from the southern villages. Particulars of the samples are given in the following table, which also shows the size and condition of the leaves:—

Sample.	Size of Leaves.	Texture and Appearance of Leaves.
I.—*Northern Villages*—		
1–a Maghar, 1st, 2nd and 3rd 1–b Kahaa, 1st, 2nd and 3rd 1–c Safad, 1st, 2nd and 3rd 1–d Yasud Hamaleh, 1st, 2nd and 3rd 1–e Firim, 1st, 2nd and 3rd 1–f Rosh Pinah, 1st, 2nd and 3rd	Good-sized leaves on the whole; mostly 4 to 6 in. long and 2 to 4 in. wide, but the size varied considerably in each sample.	Yellow leaves, of fair body, but mostly showing brown, brittle patches, and in many cases greenness. All the samples were practically alike.

Sample.	Size of Leaves.	Texture and Appearance of Leaves.
II.—*Southern Villages*—		
2–a Kakoun, 1st, 2nd, 3rd and 4th (mixed)	5 to 11 in. long and 2½ to 5½ in. wide; many leaves rather large for Turkish tobacco	Light brownish-yellow to dark brown, almost black in places; many leaves showing pronounced greenness. Texture variable; inclined to be papery and brittle.
2–b Richon le Zion, 1st and 2nd	4 to 8 in. long and 2 to 4 in. wide	Pale sandy yellow; mostly showing brown patches. Texture on the whole satisfactory. Some slight greenness and some weak patches.
2–b Richon le Zion, 3rd and 4th	4 to 8 in. long and 2 to 4 in. wide	Variable in colour; mostly light sandy yellow, with a good many brown patches. Many leaves showed pronounced greenness. Fair substance; on the whole inclined to be weak.
2–c Petach-Tikvah, 1st and 2nd	4 to 10 in. long and 2 to 5 in. wide; a few smaller	Light brownish-orange; some leaves showing greenness. Texture on the whole fair; some leaves inclined to be brittle.
2–c Petach-Tikvah, 3rd .	3 to 8½ in. long and 1½ to 4½ in. wide; a few smaller.	Similar to preceding sample, but not of quite such good appearance and showing more greenness.
2–c Petach-Tikvah, 4th .	3½ to 9 in. long and 1½ to 4½ in. wide	Colour variable; mostly brownish-orange. Inclined to be papery.
2–d Kadarah, 1st and 2nd .	5 to 10½ in. long and 2½ to 5 in. wide	Sandy yellow, with brown patches. Satisfactory texture.
2–d Kadarah, 3rd . .	4 to 9 in. long and 2 to 5 in. wide	Brownish-orange; some leaves showing pronounced greenness. Fair body but many leaves inclined to be brittle.
2–d Kadarah, 4th . .	3½ to 9 in. long and 1½ to 4½ in. wide	Colour variable; on the whole brownish-orange. Many leaves showed pronounced greenness. Leaves on the whole inclined to be weak and brittle.

The samples 1–d, 1–f and 2–a were taken for chemical examination. After removal of the midribs these tobaccos were analysed with the following results, which are calculated for tobacco containing 14 per cent. of moisture :—

	1–d. Per cent.	1–f. Per cent.	2–a. Per cent.
Moisture	14·0	14·0	14·0
Nicotine	2·87	2·23	2·18
Nitrogen	1·88	1·92	2·51
Ash	14·0	13·1	16·2

These results show that the tobaccos contained fairly normal quantities of nicotine and nitrogen.

The results of the analysis of the ash were as follows :—

		1–d.		1–f.		2–a.	
		Per cent.	Calculated on CO_2-free ash Per cent.	Per cent.	Calculated on CO_2-free ash. Per cent.	Per cent.	Calculated on CO_2-free ash Per cent.
Lime . . .	CaO	46·23	53 57	45·81	55·63	37·99	45·48
Magnesia . .	MgO	7·16	8·30	6·05	7·35	11·27	13·50
Potash . . .	K_2O	9·53	11·04	9·20	11·17	9·09	10·88
Soda . . .	Na_2O	1·52	1·76	0·86	1·04	1·21	1·45
Sulphates, expressed as sulphuric anhydride . . .	SO_3	5·78	6·70	4·56	5·54	3·18	3·81
Chlorides, expressed as chlorine . .	Cl	3·21	3·72	2·69	3·27	7·79	9·33
Carbonates, expressed as carbon dioxide .	CO_2	13·70	—	17·64	—	16·51	—

In all three samples, the ash contained a low amount of potash and a rather high total percentage of sulphates and chlorides ; in sample 2–a the amount of chlorides alone was excessive.

The samples were submitted to smoking trials, with the following results :—

I. *Northern Villages.*—The six samples of this set burnt well and yielded a white to grey ash, occasionally showing some black portions. They had a distinct flavour, rather full for Turkish leaf and somewhat coarse and pungent.

II. *Southern Villages.*—These samples were, in general, similar in smoking quality to those from the Northern villages, but with the exception of 2–a and 2–b (1st and 2nd) were rather more pungent and coarse. Samples 2–c (3rd) and 2–c (4th) did not burn so well as the others. All the tobaccos yielded darker ash than those of Set I, that of 2–a being the lightest in colour of this Set.

The tobaccos were submitted to merchants and to brokers, who furnished the following observations :—

(1) The merchants did not consider that under present conditions this Palestine tobacco would be of much interest in the United Kingdom, in view of the fact that Turkish tobaccos are now being produced in countries of the Empire, such as Rhodesia and South Africa, which enjoy the preferential rate of import duty.

(2) The brokers described the tobaccos as rather coarse and bitter in smoking, of a weedy character, and lacking in toughness. In their opinion such leaf could only be marketed in the United Kingdom at a low price, for use as a blending material in cheap Turkish cigarettes, but they doubted whether grades 2–a (1st, 2nd, 3rd and 4th grades mixed), 2–b (3rd and 4th grades mixed) and 2–c (4th grade) would be saleable here even for this purpose. They furnished the following nominal valuations for certain of the samples :—

Sample.	Value per lb. (Aug. 1925)
1–d (1st, 2nd, 3rd, mixed)	1*s*. 9*d*. to 2*s*.
1–e (1st, 2nd, 3rd, mixed)	1*s*. 6*d*. to 1*s*. 8*d*.
1–f (1st, 2nd, 3rd, mixed)	1*s*. 6*d*.
2–b (3rd and 4th mixed)	9*d*. to 1*s*.
2–c (1st and 2nd mixed)	1*s*. 3*d*. to 1*s*. 6*d*.
2–c (3rd grade)	1*s*. to 1*s*. 3*d*.

The firm offered to take charge of a small trial shipment, if desired, in order to test the market in this country, but they pointed out that Palestine tobaccos would have to be sold in strong competition with supplies of similar quality from Greece, Bulgaria and elsewhere.

General Remarks.—From the results of the chemical examination of samples 1–d, 1–f and 2–a it will be seen that the ash is characterised by rather high amounts of sulphates and chlorides, whilst the percentage of potash is low. The two former constituents have a bad effect on the burning quality of the leaf, whilst potash is beneficial. The present samples burn satisfactorily with the exception of 2–c (3rd) and 2–c (4th), but the results of the analysis of the ash of samples 1–d, 1–f and 2–a suggest that the soils on which these tobaccos were grown may contain barely sufficient potash to counteract the effect of the large proportion of sulphates and chlorides present, and that unless appropriate manuring is adopted the burning

properties of the leaf of succeeding crops may be adversely affected. The samples from the Southern villages include samples of "Grade 4" leaf, which was generally darker than the other tobaccos, but on the whole the colour of the leaf was good in both sets. The best samples in this respect were Nos. 1–c, 1–d and 1–e, followed by 2–b (1st and 2nd mixed) and 2–c (1st and 2nd mixed); whilst the darkest tobaccos were 2–a, 2–c (4th), 2–d (3rd) and 2–d (4th).

The pungency and coarseness could be considerably reduced by adopting bulk fermentation, whilst excess of nitrogenous manures (which tend to produce these properties) should be avoided.

In submitting the foregoing report to the Palestine authorities it was stated that, if so desired, the Imperial Institute would be prepared to receive a small consignment of Palestine tobacco for sale in London through the brokers who valued the present samples. It was pointed out that, in order to obtain the best price, it would be well to avoid mixtures of grades or varieties, and to omit the 3rd and 4th grades entirely; and further, that the leaf should be packed in such a condition as to contain from 12 to 14 per cent. of moisture on arrival in this country.

NIGERIA.

The natives of Nigeria have cultivated tobacco for a long time past, and small plots are to be found in nearly every village in the Northern Provinces. Very little of the native leaf is smoked, however, and it is mainly employed for chewing or for snuff. For the former purpose the leaf is finely crushed and mixed with oil and a little pepper; for snuff it is simply ground into a fine powder. The pipe tobacco smoked by the natives is mainly imported "black leaf," whilst imported cigarettes are now to be found in nearly every native market.

Considerable care is taken by the natives in cultivating tobacco; irrigation is commonly practised and the soil is always well manured. In harvesting, however, leaves of all ages are gathered at the same time and the curing is effected by a very primitive method, with the result that the bulk of the tobacco is unfit for export.

For the past ten years the Nigerian Department of Agriculture has endeavoured to improve the quality of the tobacco by conducting cultivation and selection trials and curing experiments, and by encouraging the natives to prepare from the local tobaccos a leaf of better quality. In 1915 the Department commenced experiments with the object of producing a "bright" tobacco of the Virginia type, and seed of well-known American varieties was imported. The results obtained at the Ilorin Experiment Station, in the Northern Provinces, during the first year were distinctly promising. Four samples of the tobacco, comprising three American varieties and one local form, were examined at the Imperial Institute and found to be quite suitable for the English market although the colour was not very satisfactory (see this BULLETIN, 1917, **15**, 32).

There is no doubt that the soil in many parts of Northern Nigeria is suitable for the crop, and that the production of a good "bright" tobacco depends mainly on the adoption of a satisfactory method of curing.

Under the climatic conditions obtaining in the country flue-curing barns seem to be essential for the best results. These are out of the question, however, so far as the native grower is concerned, and the efforts of the Department have in recent years been directed to improving the native methods of sun- and air-curing. Considerable trouble has been taken to demonstrate the best methods to the growers and great improvement has been effected in some districts. On the whole, however, much difficulty has been experienced in inducing the natives to produce even a low-grade tobacco for export. During the last few years the Department has held an annual market and has bought any tobacco offered for sale that was considered to be at all suitable for export. In order to encourage the native growers, the prices paid by the Department were higher than was strictly justified by the prices obtainable on the sale of the tobacco in England, and represented the estimated approximate value which it was considered the tobacco should realise if exported on a large scale. The people of one particular village consistently produced a relatively considerable quantity of tobacco of a fair standard of quality, and it was hoped that by continuing the market from year to year the

production of tobacco for export would spread to other villages. A number of villages successively attempted the production on a small scale, with the assistance of instructors, but afterwards abandoned it. It has been decided therefore that the industry is not sufficiently attractive to native growers at present to warrant any further attempt being made by the Department to establish it, and the efforts have now been discontinued.

For a number of years the tobacco purchased from the natives, together with a certain amount of leaf produced at the Government Farm at Ilorin, has been sent to the Institute for examination and sale by brokers in order to test the market. It has been found that in general the consignments have consisted of low-grade leaf, suitable only for cheap smoking mixtures and shags. They have been sold in competition with leaf of similar grade from India, of which large quantities are usually available on the market. The consignment received in 1925 was the best so far exported, and the following extracts from the report furnished to the Government of Nigeria will be of interest as indicating the character of the better kinds of leaf produced by the native grower.

The consignment consisted of fourteen bales weighing about 1 cwt. each. A sample was drawn from each bale and examined at the Imperial Institute with the following results :—

Bale No.	Size of Leaves, inches.	Colour.	Texture.
1	16 × 5 to 17 × 9	Yellow to dark orange	Of fair to heavy substance and rather broken.
2	17 × 5 to 30 × 13	Orange to dark reddish-brown	Mostly of fairly heavy substance ; some of the leaves were brittle. Somewhat torn, and some leaves badly spotted.
3	15 × 5½ to 20 × 9	Light orange-brown	Thin, weak, and slightly spotted. The butts had been removed from some of the leaves.
4	20 × 6 to 28 × 14	Dark orange-brown	Varying from thin to heavy in substance. Some of the leaves were coarse and some slightly spotted. This sample was very earthy.
5	18 × 4 to 25 × 10	Pale brown to medium orange-brown ; a few of the leaves were dark reddish-brown	Thin to fair substance. Many leaves badly torn.

Bale No.	Size of Leaves, inches.	Colour.	Texture.
6	14×5 to 27×14 .	Pale orange to medium brown; some leaves mottled	Thin to fairly heavy in substance. Some leaves badly torn.
7	16×5 to 24×13 .	Pale to medium orange-brown	Thin and somewhat torn.
8	16×7 to 20×8 .	Yellow to dark orange-brown; some leaves mottled	Substance thin to fair. Some leaves brittle and some slightly broken. Slightly spotted.
9	16×5 to 23×10 .	Mottled orange to dark reddish-brown	Fair to heavy substance. The butts had been removed from some of the leaves.
10	12×4 to 17×9 .	Yellow to mahogany, but mostly orange	Substance thin to fair, but some leaves inclined to be papery. Rather torn.
11	11×3 to 21×9 .	Yellow to dark reddish-brown	Thin to fairly heavy substance. Some of the leaves showed greenness. Somewhat torn and of poor appearance.
12	14×6 to 18×9 .	Light brown to dark orange-brown; some leaves mottled	Thin to fairly heavy substance. Some leaves torn and of poor appearance.
13	10½×3 to 16×7 .	Orange to medium orange-brown	Thin to fair substance.
14	11×4 to 22×10 .	Yellow to dark reddish-brown	Thin to fair substance. Some leaves were slightly spotted and some showed greenness. Some brittle and torn.

All the samples were found to contain an excess of moisture, although they had probably dried to some extent subsequent to their withdrawal from the bales at the warehouse, and some showed evidence of having become heated.

The leaves were generally of narrow shape and had heavy stalks which were rather bare at the butt ends; some fairly broad leaves were, however, present. On the whole the leaves were larger, lighter in colour and of better substance than those of the earlier consignments from Nigeria.

Smoking trials were made with the best, the worst, and some mixed leaves, in both pipe and cigarette form. In all cases the leaf burnt well, leaving a white to grey ash. The smoke was very pungent and the flavour rough and strong, these features being chiefly, if not entirely, attributable to lack of curing.

The sale of the tobacco was placed in the hands of the brokers through whom the previous consignments had been sold. All the tobacco was in a very moist condition and at the suggestion of the brokers the whole of the consignment was dried at the docks, and three of the bales "garbled" in order to facilitate its sale. The price eventually obtained for the whole consignment was 9½*d.* per lb.

As regards the quality of the consignment, the brokers reported that the tobacco itself was better than that of the previous lots, being longer, tougher and of better colour; it had, however, large stalks and was rather bare at the butts.

Summarising the conclusions to be drawn from the results of the examination and sale of the consignments of Nigerian tobacco forwarded to the Imperial Institute, it may be stated that the samples of native-produced leaf indicate that there is a good prospect of producing in Nigeria a good grade of leaf suitable for the United Kingdom market provided that better curing methods are adopted. The burning properties are satisfactory and the defects in the flavour of the tobacco are due largely to the method of preparation. It may, therefore, be concluded that the soil and climate are satisfactory for the production of pipe tobaccos. Further trials with other varieties of seed and improved methods of preparation would demonstrate the possibility of producing other classes of leaf.

The tobacco from the Government Farm at Ilorin has been generally of very promising quality, and analyses of the ash, which have been made at different times, show that the mineral constituents of the leaf are satisfactory, indicating that the soil is of suitable character for the crop.

Mauritius.

Tobacco is not at present an important crop in Mauritius, and is grown only for making "tabac bleu" for the local market. Samples of this tobacco examined at the Imperial Institute in 1922 were found to be unsuitable for the English market, and it was suggested to the Department of Agriculture that if it were desired to grow tobacco in Mauritius for export to the United Kingdom, probably the best procedure would be to devote attention, in the first instance, to the production of a leaf suitable for use as cigar fillers. In accordance with this

suggestion, seed of three varieties of filler tobacco were obtained by the Imperial Institute from the United States and forwarded for trial cultivation in Mauritius. Samples of the tobaccos grown at the Royal Botanical Gardens, Pamplemousses, and in Rodrigues, were subsequently sent to the Institute for examination.

The faults exhibited by the tobaccos were in large part due to unsatisfactory curing caused by lack of knowledge and skill. This was recognised by the authorities in Mauritius, who, at the close of 1924, sent Mr. G. Corbett, Agricultural Superintendent, Rodrigues, to South Africa, Rhodesia and Nyasaland, to study the methods of tobacco cultivation and curing practised in those countries.

His *Report* on the tour, containing much information of practical value, together with recommendations regarding the extension of the tobacco industry in Mauritius, has recently been published by the Department. He considers that the types most suitable for cultivation in the island are the intermediate and dark types. The soils of Mauritius, generally speaking, are too heavy and rich in nitrogen for the production of bright cigarette leaf, and they lack the phosphates essential for growing such tobacco of good quality. Mr. Corbett recommends experimenting with such varieties as " Gold Leaf " and " Blue Pryor " for fire-curing and " White Burley " for air-curing. While these experiments are being carried out he suggests that the "Tabac Bleu," already produced in Mauritius, should be fermented in bulk to ascertain whether it can be improved by this means. With regard to the possibility of producing cigar leaf in Mauritius, Mr. Corbett is not very hopeful, but he states that as he saw no cigar leaf on his tour he is not in a position to give a definite opinion.

The tobaccos received for examination were as follows; the yields quoted in the case of the first three samples are based on the results of small trial plots, and have been taken from a statement furnished to the Imperial Institute by the Agricultural Superintendent of the Royal Botanic Gardens, Pamplemousses.

No. 1, Cuban tobacco from Royal Botanic Gardens, Pamplemousses.—This gave a yield at the rate of 205 tons of dried leaf per acre. Leaves from 11 to 17 ins. long and 4

to 9 in. broad, of dull brown colour and showing much greenness ; a few leaves were reddish-brown, and some were rather spotted. The leaves were of good shape, with fairly small midribs and rather wiry veins. A few were of fairly fine texture, but on the whole the leaves were coarse.

No. 2. Zimmer Spanish tobacco from Royal Botanic Gardens, Pamplemousses.—The yield of dried leaf in this case was at the rate of 259 tons per acre. Leaves from 12 to 18 in. long and 5 to 9 in. broad. The colour was mostly dull brown, but it was somewhat uneven, some leaves being light brown and a few rather reddish ; the leaves showed much greenness, and some were spotted. They were rather weak and similar in texture to the sample of Cuban leaf, No. 1.

No. 3. Connecticut Broad Leaf tobacco from Royal Botanic Gardens, Pamplemousses.—This variety gave the smallest yield, viz., at the rate of 187 tons of dried leaf per acre. Leaves from 10 to 15 in. long and 2½ to 8 in. broad, of medium reddish-brown colour ; they showed much greenness (though less than samples Nos. 1 and 2), and most of them were badly spotted. The leaves were on the whole rather small, with small midribs and rather wiry veins. They were fairly thin in texture but harsh and weak.

No. 4. Zimmer Spanish tobacco from Rodrigues.—Leaves from 14 to 24 in. long and 6 to 12 in. broad, of a dull brown colour and showing much greenness. The midribs were fairly small, but the veins were prominent and wiry. The leaves were fairly fine in texture but inclined to be harsh and weak.

No. 5. Connecticut Broad Leaf tobacco from Rodrigues.—Leaves from 12 to 17 in. long and 4½ to 9 in. broad, from light to dark reddish-brown and showing much greenness. The midribs were fairly small, the veins prominent and wiry, and the texture fairly thin but harsh and weak.

The samples were analysed with the results given in the following table, which are calculated for material containing 14 per cent. of moisture :—

	No. 1. *Per cent*	No. 2. *Per cent.*	No. 3. *Per cent.*	No. 4 *Per cent.*	No 5. *Per cent.*
Moisture . .	14·0	14·0	14·0	14·0	14·0
Nicotine . .	2·22	3·13	3·78	4·62	5·45
Nitrogen . .	3·21	2·72	2·96	4·06	4·35
Ash . .	16·0	16·2	14·6	16·0	15·3

The ash was analysed in the case of samples 2 and 4 and found to contain :—

		No. 2.		No. 4.	
		Per cent.	Expressed on ash free from carbon dioxide. Per cent.	Per cent.	Expressed on ash free from carbon dioxide. Per cent.
Lime	CaO	33·43	38·46	20·53	23·12
Magnesia	MgO	13·04	15·00	21·09	23·74
Potash	K_2O	19·15	22·03	24·16	27·20
Soda	Na_2O	2·28	2·62	1·68	1·89
Sulphates, expressed as sulphuric anhydride . . .	SO_3	4·91	5·65	4·14	4·66
Chlorides, expressed as chlorine	Cl	12·99	14·95	15·40	17·34
Carbonates, expressed as carbon dioxide . . .	CO_2	13·08	—	11·19	—

The three samples from Pamplemousses on burning yielded a coherent grey ash, tinged with brown. The aroma was very pungent, and the flavour full, strong, and inclined to rankness.

The tobaccos from Rodrigues gave an ash resembling in colour and appearance that of the samples from Pamplemousses. The flavour and aroma of the Connecticut leaf No. 5 were not so good as those of the Zimmer Spanish tobacco No. 4, and both samples were inferior in these respects to the corresponding tobaccos grown at Pamplemousses.

The tobaccos were submitted to brokers and manufacturers in London, whose attention was called to the fact that the preparation had been defective owing to the lack of expert assistance.

The brokers stated that the tobacco was unsuitable for cigar manufacture, as it was not only thick and gummy but when used as cigar bunch or filler it would not burn properly and the flavour was very objectionable. Such tobaccos would therefore not be saleable for cigar-making, and as regards their possible use as cutting tobaccos they would have to be sold in competition with common grades, such as those imported from India, and would be worth about 4d. to 7d. per lb. in London.

The manufacturers tested the samples in the form of cigars, but found the taste to be very strong and unpleasant and the combustion extremely poor. They observed that the veins of sample No. 4 were coarse, but that as Zimmer Spanish tobacco is used in the United States principally as a cigar filler this in itself might not be an important objection,

provided that well-fermented leaf of good burning and tasting qualities could be obtained. The firm considered it difficult to judge from the samples, as to whether proper preparation and curing would result in the production of useful and saleable leaf.

General Remarks.

These five samples of tobacco were of very poor colour for cigar leaf and showed much greenness, whilst the flavour on smoking was strong and unpleasant. The preparation was admitted to have been defective and there is no doubt that if the samples had been properly cured their appearance and flavour would have been considerably improved.

The dull colour indicates that the leaves were harvested in an unripe condition, and the greenness shows that the curing was defective. The colour to be aimed at is a light cinnamon-brown, free from redness. The thatched open shed used in Rodrigues would not be satisfactory for curing, for which it is necessary to have a properly constructed curing shed.

The results of the chemical examination show that in the three samples from Pamplemousses the amounts of nitrogen and nicotine were satisfactory, but that in the two samples from Rodrigues the percentages of these constituents were much higher. The high percentage of nitrogen in the samples from Rodrigues indicates that the soil on which they were grown contains too much nitrogenous organic matter. Cigar leaf needs a soil fairly rich in nitrogen in order that there may be no check to the plants during the growing period, but if too large an amount is present the composition of the leaf is adversely affected.

The analysis of the ash of the samples of Zimmer Spanish leaf (Nos. 2 and 4) shows a high percentage of chlorides, which have a detrimental effect on the burning properties. In both cases, however, the ash also contained a large proportion of potash, which would tend to compensate the effect of the chloride. The presence of a large amount of chlorides is an objectionable feature in tobacco soils.

Both at Pamplemousses and in Rodrigues the Zimmer Spanish variety has given the best leaves as regards size. It is also noteworthy that both the tobaccos grown in Rodrigues

produced larger leaves than the same varieties at Pamplemousses. It would, however, be unwise, from the present sampl alone, to draw any conclusions regarding the best variety to grow.

It was suggested in the report that it would be desirable not only to continue the trials, as proposed, but also to make arrangements for the treatment and handling of the crop under expert supervision, including the provision of suitable curing barns. It was pointed out that until this had been done no trustworthy opinion could be formed as to the prospects of cigar leaf production in Mauritius, as it is not certain how far the unsatisfactory features of the present samples were due to faulty handling and how far to local characteristics. There is no doubt, however, that the colour and flavour of the tobaccos could be greatly improved by better fermentation.

PERILLA SEED.

In an article published in this BULLETIN (1920, **18**, 479) attention was called to the possibility of growing perilla seed (*Perilla ocymoides*) in countries of the British Empire. It was pointed out that the seed yields a valuable drying oil and that at present supplies of the seed are derived principally from Manchuria, China and Japan, the oil being produced chiefly in the last-named country. The oil is used largely in the paint and varnish industry in the United States and the cultivation of the plant has been started in Florida to supply the American market.

In order that cultivation experiments might be undertaken in various parts of the Empire a supply of seed was obtained by the Imperial Institute from Japan, and forwarded to a number of countries, including Cyprus, the Union of South Africa and Rhodesia. A report on a sample of seed grown in the first-named country was printed in the above-mentioned article. Samples have since been received from South Africa and Rhodesia, and the results of their investigation are given in the present article, together with the results of examination of seed from India and Hong Kong.

Union of South Africa.—Two samples of seed were received in 1923 and 1925, respectively. In the former case the Imperial Institute was informed that only two rows, each about 10 ft. long, could be planted, the plants being set 6 in. apart. The yield was 3 lb. In the case of the second sample a little over one ounce of seed was sown on one-fifth acre ; 50 lb. of seed was harvested from the plants.

Southern Rhodesia.—Two samples grown at the Agricultural Experiment Station, Salisbury, were received in 1923 and 1924, respectively. The soil on which the first sample had been grown was not in a high state of fertility, and although the seed germinated well, giving a 95 per cent. stand, the yield of seed from the small plot planted was only at the rate of 54 lb. per acre.

In the second case the soil was good, but the germination poor, the stand being only 40 per cent. The yield was again low, being practically the same as before, viz., 55 lb. per acre. The rainfall in the second year was 17 in. as compared with 42½ in. in the previous year, and in view of the poor stand in the second year, it would appear that a low rainfall is suitable for the plant in Southern Rhodesia.

The Chief Agriculturist states that under Rhodesian conditions the plant is slow-growing and would require to be sown on land free from weeds. He points out that the seed capsules ripen unevenly, while the seeds are shed very freely, so that considerable care is necessary in handling the plants during the harvesting. He considers that the cultivation of perilla seed would not be profitable in the colony unless a yield of at least 200–300 lb. of seed per acre could be relied on.

India.—Three samples of perilla seed from India were received in 1918. The plant is grown by the natives in the Khasia hills, in the Naga hills and in Manipur, and a sample from each of these localities was forwarded in order to determine the quality of the seed produced there.

Hong Kong.—A sample of seed gathered from plants grown experimentally by the Botanical and Forestry Department in the Sheung Shui Garden, was received in 1925.

The seed from South Africa, Southern Rhodesia and Hong Kong was of normal appearance. That from the Khasia hills

was light brown in colour and smaller than the other two Indian samples. The sample from the Naga hills consisted of mixed seed, cream or brown in colour, and containing foreign seed, resembling black sesame seed to the extent of 2–2½ per cent. of the total. The seeds from Manipur were light brown, with a slight pinkish tint.

The results of the examination of the seeds and of the oils obtained from them by extraction with light petroleum are shown in the table on page 208. For comparison, the constants given in the tentative standard for perilla oil drawn up by the American Society for Testing Materials in 1922, are included in the table.

It will be seen from the table that all the samples gave a satisfactory yield of oil. The constants of the oils comply with the American standard specification, except that in all cases but one the iodine value, as determined by the Hübl method, was somewhat low, and that in two instances the acid value was much above the maximum permitted.

As regards the commercial value of the seed in the United Kingdom, it appears that the seed has not hitherto been imported into this country. The Imperial Institute, therefore, consulted a firm of oil-seed crushers in connection with the second sample of South African seed, and they expressed their willingness to purchase a trial consignment of 100 tons. They estimate that the present value of the seed would be about £15 per ton, on the assumption that the residual cake could not be used as a feeding stuff, but only as a manure. Experiments made on the Continent suggest, however, that the cake is suitable for use as a cattle food, and if this is confirmed the value of the seed would be correspondingly increased. This point cannot be definitely settled until a commercial consignment of the seed has been crushed and a suitable quantity of the cake is available for trial.

It has been shown by the foregoing investigations that perilla seed yielding oil of satisfactory quality can be grown in certain countries, and the question of the extended production of the seed within the Empire and in certain cases of the preparation of the oil for export deserves further consideration.

	Union of South Africa.		Southern Rhodesia.		India.			Hong Kong.	American Specification.
	1923.	1925.	1923.	1924.	Khasia Hills.[2]	Naga Hills.	Manipur.		
Seed—									
Moisture . *per cent.*	6·3	7·1	7·0	7·3	6·5	5·8	6·2	6·4	—
Oil, expressed on seeds as received[1] . *per cent.*	44·2	41·4	37·2	35·7	41·8	44·5	46·0	37·6	—
Oil, expressed on moisture-free seeds . *per cent.*	47·3	44·6	40·0	38·5	44·7	47·2	49·0	40·2	—
Oil—									
Specific gravity at 15° C. .	0·932	0·932	0·931	0·932	—	0·931	0·934	0·933	0·932 (min.)
Acid value . . .	2·1	5·3	21·6	1·4	—	28·1	5·1	1·5	5·0 (max.)
Saponification value. .	191·9	190·2	190·7	189·2	—	197·6	194·7	192·0	190·0 (min.)
Iodine value (Hübl, 17 hours) . *per cent.*	184·0	186·1	179·9	175·4	—	189·0	193·0	189·3	191·0 (min.)[2]
Unsaponifiable matter *per cent.*	1·2	1·1	0·9	0·7	—	—	—	1·5	1·5 (max.)
Refractive index at 40° C.	1·476	1·4735	1·473	1·473	—	—	—	1·4735	—

[1] *The yield of oil recorded ranges from 33 to 45 per cent. and is usually about 36 per cent.*

[2] *This sample was too small to determine the constants of the oil.*

by

ARTIFICIAL AGEING TESTS ON PLANTATION RUBBER.

The following is a report of the London Committee of the Ceylon Rubber Research Scheme on the results of artificial ageing tests on plantation rubber carried out at the Imperial Institute in connection with the scheme, the objects of which are described in this BULLETIN (1925, **23**, v).

It is well known that vulcanised rubber articles eventually perish on exposure to light and air, and this question has received much attention from manufacturers. Numerous attempts have been made, by additions to the rubber mixings, to prevent this deterioration in the physical properties of vulcanised rubber and continued efforts to effect improvement in this direction are part of the routine of rubber factory practice.

It seems possible that different methods of preparing plantation rubber may have some effect on the ageing properties of the vulcanised product, but this aspect of the question has received comparatively little attention.

De Vries[1] carried out a series of experiments on this point and his conclusions may be summarised as follows :—

(*a*) Coagulation of latex with different amounts of acetic acid, with sulphuric acid, with sodium chloride, or with sugar, has no effect on the ageing properties of the vulcanised product ; (*b*) the ageing properties are not affected by increasing the rolling of crepe from three to twenty-four times ; (*c*) matured rubber, balls prepared according to the Brazilian method, and rubber from evaporated latex, stretch less easily than other forms of rubber on ageing ; (*d*) crepe from the first clot in partial coagulation, and inferior crepe from washings deteriorate more rapidly in tensile strength than other forms of rubber.

On the other hand, Stevens[2] states in connection with ageing tests on single samples of crepe and smoked sheet in a rubber-sulphur mixing : " It is noteworthy that the crepe rubber

---

[1] de Vries. *Estate Rubber.* Batavia, 1920, p. 497.
[2] *Journ. Soc. Chem. Indust.* (1916, **35**, 874).

compounds cured for 3, 3½ and 4 hours all show greater deterioration over any given period than the corresponding sheet rubber compounds. I am inclined to attribute this to the method of preparation." In subsequent experiments on ageing properties, however, Stevens[1] examined a number of forms of rubber including crepe and sheet, but drew no conclusions as to the effect of methods of preparation, except in the case of a recent comparison of smoked sheet and fine hard Para, where he found little difference in ageing properties.

In experiments using a zinc oxide mixing Stevens[2] again found the ageing properties of crepe to be inferior to those of smoked sheet, but suggested that this was the effect of the zinc oxide.

In the circumstances and having regard to the importance of the subject it was considered desirable to make a detailed investigation of the behaviour of ageing of different forms of plantation rubber in different mixings, and to compare the results obtained with those given by fine hard Para. This rubber is preferred to plantation rubber for the manufacture of articles where a rubber-sulphur mixing is employed (such as golf ball tape and elastic thread), and it has been suggested that this preference is connected with differences between the ageing properties of the rubbers in this mixing.

The first set of experiments was made with a series of samples (Series II) which were being submitted to vulcanising and mechanical tests. These samples consisted of duplicate sets prepared on four estates in different parts of the Island, each set consisting of crepe, crepe blocked after varying periods of drying, unsmoked sheet, and unsmoked sheet rolled up after varying periods of drying. The majority of the rolled sheets contained between 1·0 and 9·0 per cent. of moisture on arrival at the Imperial Institute, whereas, with one exception, it was only those crepes blocked immediately after machining which contained more than 1·0 per cent. of moisture. Further particulars regarding these samples and the results of the

---

[1] *Journ. Soc. Chem. Indust.* (1918, 37, 305, 340T).
[2] *Bull. Rubber Growers' Assoc.* (1920, 2, 270).

vulcanising and mechanical tests are given in Bulletin No. 40 of the Ceylon Rubber Research Scheme. It was considered that the wet samples might be of special interest for comparison with fine hard Para, which contains appreciable amounts of moisture on arrival at the factory.

The standards of vulcanisation generally adopted in rubber testing are selected chiefly with a view to obtaining information as to maximum tensile strength. Samples vulcanised to this extent, however, are technically " overcured " and deteriorate very quickly on ageing. It was accordingly decided to adopt a less advanced standard of cure in these experiments, and after consultation with the representatives of manufacturers on the Committee, a cure giving an elongation of 860 ± 20 per cent. under a load of 1·04 kgs./sq. mm. was selected.

In consequence of the time involved in carrying out natural ageing tests and the difficulty of maintaining uniform conditions, it is the general practice to test the ageing properties of vulcanised rubber by exposing suitable specimens to a temperature of 60° to 80° C. in a slow current of air. In the case of the present experiments, Schopper rings were submitted to a temperature of 70° C. for definite periods. They were then kept for twenty-four hours at atmospheric temperature before testing, four rings being broken in each case to obtain an average result. The effect of exposing rubber for twenty-four hours at 70°C. in a current of air is usually regarded as equivalent to that of storage in the dark for six months under ordinary conditions.

It was originally intended to test the samples only after ageing for 48 hours but, as the crepe and sheet specimens in the first set examined (from Matale) showed great differences in tensile strength at the end of this period, it was considered desirable to investigate the effect of ageing for longer and shorter times. The next set (from the Kelani Valley) was accordingly tested after ageing for 24 and 48 hours, and the remaining two sets (from Uva and Kalutara) after 48, 96 and 144 hours.

The average results obtained at each of the above periods of ageing are summarised in the following pages. The detailed results of the tests on each sample are given in the appendix to Bulletin No. 41 of the Ceylon Rubber Research Scheme.

(1) *Effect of Ageing for* 48 *Hours at* 70°C.

The following are the average results obtained for the whole of the series before and after artificial ageing for 48 hours :—

District.	Crepe, Control (one sample from each estate). Before Ageing. Tensile Strength. (lb./sq. in.)	Crepe, Control. Before Ageing. Elongation at 1·04 kgs./sq. mm. (per cent.)	Crepe, Control. After Ageing 48 hours. Tensile Strength. (lb./sq. in.)	Crepe, Control. After Ageing 48 hours. Elongation at 1·04 kgs./sq. mm. (per cent.)	Blocked crepe (average of five samples from each estate). Before Ageing. Tensile Strength. (lb./sq. in.)	Blocked crepe. Before Ageing. Elongation at 1·04 kgs./sq. mm. (per cent.)	Blocked crepe. After Ageing 48 hours. Tensile Strength. (lb./sq. in.)	Blocked crepe. After Ageing 48 hours. Elongation at 1·04 kgs./sq. mm. (per cent.)
Matale	1,930	875	1,860	759	2,130	867	2,100	752
Kelani Valley	2,030	856	2,130	752	2,010	862	2,150	753
Uva	1,940	865	2,320	791	1,950	870	1,970	779
Kalutara	1,930	843	1,990	766	1,910	858	2,070	763
Average	1,960	860	2,080	767	2,000	864	2,070	762

District.	Unsmoked sheet, Control (one sample from each estate). Before Ageing. Tensile Strength.	Unsmoked sheet, Control. Before Ageing. Elongation.	Unsmoked sheet, Control. After Ageing. Tensile Strength.	Unsmoked sheet, Control. After Ageing. Elongation.	Unsmoked sheet, rolled up wet (average of five samples from each estate). Before Ageing. Tensile Strength.	Unsmoked sheet, rolled up wet. Before Ageing. Elongation.	Unsmoked sheet, rolled up wet. After Ageing. Tensile Strength.	Unsmoked sheet, rolled up wet. After Ageing. Elongation.
Matale	2,320	857	2,760	745	2,340	862	2,720	742
Kelani Valley	2,190	870	2,680	750	1,830	862	2,470	741
Uva	1,710	880	1,940	807	2,220	861	2,380	763
Kalutara	2,200	871	2,360	794	2,230	855	2,580	750
Average	2,110	870	2,440	774	2,150	860	2,540	749

In the case of all these forms of rubber the effect of ageing for 48 hours is on the average to diminish the elongation by about 100 per cent. of the original length ; the tensile strength of the sheets generally shows a marked but variable increase, whereas that of the crepe shows little alteration.

The amount of moisture in the rolled sheet and blocked crepe has no effect on the ageing properties of the rubber, nor has blocking the crepe and rolling up the sheet.

(2) *Effect of Ageing for* 24 *and* 48 *Hours at* 70°C.

The set of samples from Kelani Valley was tested after ageing for 24 and 48 hours, and the average results are given in the following table :—

District.	Before Ageing.		After Ageing 24 hours.		After Ageing 48 hours.	
	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.
	(lb./sq. in.)	(per cent.)	(lb./sq. in.)	(per cent.)	(lb./sq. in.)	(per cent.)
Crepe, Control (one sample).						
Kelani . .	2,030	856	2,340	790	2,130	752
Blocked Crepe (average of five samples).						
Kelani . .	2,010	862	2,270	792	2,150	753
Unsmoked Sheet, Control (one sample).						
Kelani . .	2,190	870	2,680	782	2,680	750
Unsmoked Sheet, rolled up wet (average of five samples).						
Kelani . .	1,830	862	2,430	778	2,470	741

These results indicate that the crepe specimens increase in strength a little after ageing 24 hours, but weaken again after 48 hours. On the other hand the unsmoked sheet specimens show a marked increase in strength after ageing for 24 hours, which is still retained after ageing for 48 hours.

(3) *Effect of Ageing for* 48, 96 *and* 144 *Hours at* 70°C.

The specimens from Uva and Kalutara were aged for 48, 96 and 144 hours in order to determine whether the differences between the crepe and unsmoked sheet persist after further ageing. The average results given by these two sets are shown below :—

District.	Before Ageing.		After Ageing 48 hours.		After Ageing 96 hours.		After Ageing 144 hours.	
	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.	Tensile Strength.	Elongation at 1·04 kgs./sq. mm.
	(lb./sq. in.)	(per cent.)	(lb./sq. in.)	(per cent.)	(lb./sq. in.)	(per cent.)	(lb./sq. in.)	(per cent.)
Crepe, Control (one sample from each estate).								
Kalutara .	1,930	843	1,990	766	170	—	—	—
Uva . .	1,940	865	2,320	791	1,890	744	300	—
Blocked Crepe (average of five samples from each estate).								
Kalutara .	1,910	858	2,070	763	1,510	722	520	702
Uva . .	1,950	870	1,970	779	1,490	729	320	697
(Unsmoked Sheet, Control (one sample from each estate.)								
Kalutara .	2,200	871	2,360	794	2,390	741	2,320	721
Uva . .	1,710	880	1,940	807	2,110	756	1,780	700
Unsmoked Sheet rolled up wet (average of five samples from each estate).								
Kalutara .	2,230	855	2,580	750	2,290	703	1,610	678
Uva . .	2,220	861	2,380	763	2,100	721	1,150	690

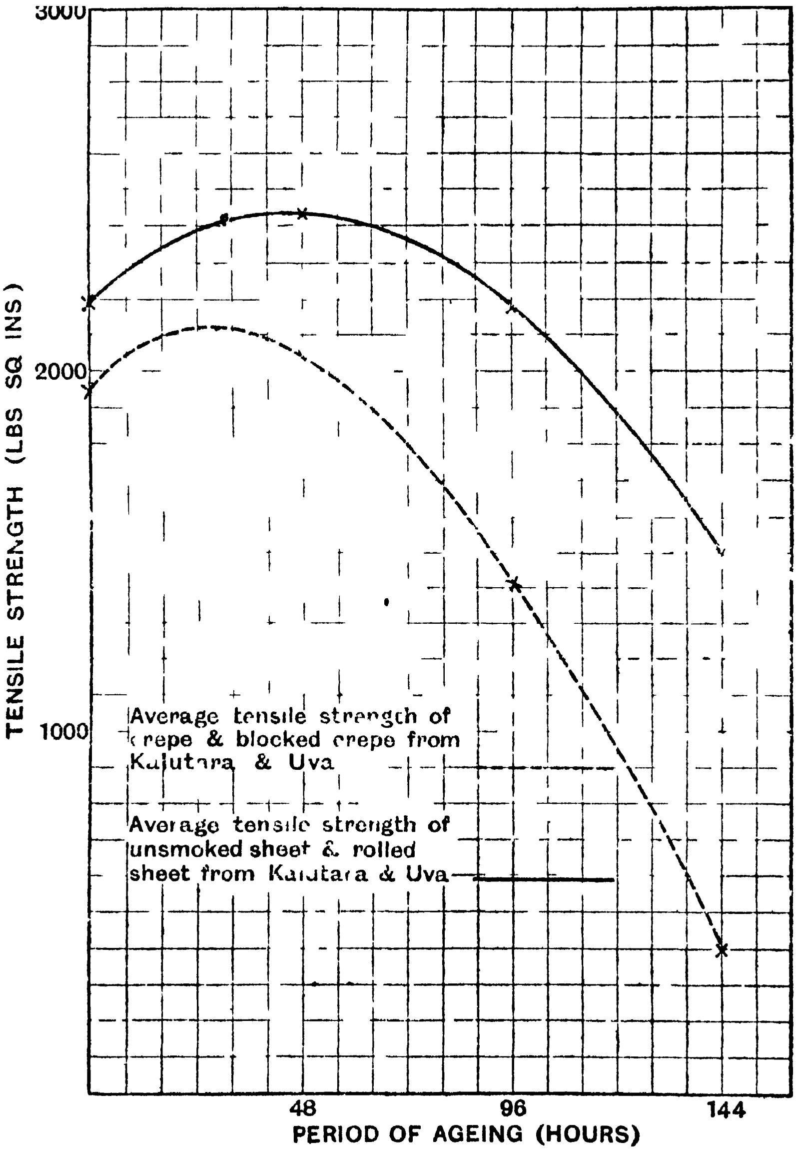
3000
2000
1000
TENSILE STRENGTH (LBS SQ INS)
48
96
144
PERIOD OF AGEING (HOURS)
Average tensile strength of crepe & blocked crepe from Kalutara & Uva
Average tensile strength of unsmoked sheet & rolled sheet from Kalutara & Uva

Fig. 1.

The above results show that whereas the crepe specimens deteriorated markedly on ageing for 96 hours, the unsmoked sheet specimens did not reach that stage until they had been aged for 144 hours. This is also shown graphically in Fig. 1 where the average tensile strengths of (*a*) the crepe and blocked crepe samples and (*b*) the sheet and rolled sheet samples from the two estates have been plotted against the period of ageing. The graphs show that the small superiority in tensile strength of sheet as compared with crepe before ageing is distinctly increased during ageing.

Effect of Degree of Vulcanisation.

In view of the inferior ageing properties of the crepe and blocked crepe as compared with the unsmoked sheet and rolled sheet at a fixed standard of vulcanisation, it was decided to investigate the effect of different degrees of vulcanisation on the ageing properties. A sample of blocked crepe (1080) and one of rolled sheet (1089), both of which were prepared from the same bulked latex, were each vulcanised for different periods and their ageing properties determined. In each case the vulcanisation coefficient was determined by the usual method, viz. oxidation after acetone extraction, and also by Kelly's method, which gives the sulphur combined with the rubber only as distinct from that combined with the "resin" and proteins.

The following table shows the vulcanisation coefficients found by the two methods, together with the results of the corresponding ageing tests:—

Time of Vulcanisation.	Vulcanisation Coefficient. (Usual Method.)	(Kelly's Method.)	Period of Ageing at 70° C.	Tensile Strength.	Elongation at load of 1·04 kgs / sq. mm.
(mins.)			(hrs.)	(lb./sq. in.)	(per cent.)
		Blocked Crepe (*No.* 1080).			
85	2·67	2·26	nil.	1,040	—
			48	1,900	925
			96	1,740	876
			144	1,680	848
99	3·49	2·70	nil.	1,680	965
			48	1,850	867
			96	1,960	810
			144	1,780	780
113	4·10	3·16	nil.	1,980	892
			48	2,020	795
			96	2,030	746
			144	340	—

Time of Vulcanisation.	Vulcanisation Coefficient. (Usual Method.)	(Kelly's Method.)	Period of Ageing at 70° C.	Tensile Strength.	Elongation at load of 1·04 kgs./sq. mm.
(mins.)			(hrs.)	(lb./sq. in.)	(per cent.)
		Blocked Crepe (*No.* 1080)—*cont.*			
120	4·32	—	nil.	2,010	860
			48	1,930	759
			96	380	—
			144	—	—
127	4·83	3·60	nil.	1,930	810
			48	1,750	689
			96	—	—
			144	420	—
		Unsmoked Sheet, rolled up wet (*No.* 1089).			
58	2·72	2·20	nil.	1,050	—
			48	1,980	976
			96	1,970	908
			144	1,570	882
67	2·92	2·31	nil.	1,360	—
			48	2,020	917
			96	2,060	870
			144	1,840	832
77	3·46	2·81	nil.	1,800	962
			48	2,080	852
			96	2,190	811
			144	1,810	793
87	4·27	3·15	nil.	1,980	917
			48	2,310	814
			96	2,110	775
			144	2,000	752
97	4·72	3·78	nil.	2,030	857
			48	2,250	756
			96	2,040	725
			144	1,530	700

The difference between the two coefficients indicates the amount of sulphur, insoluble in acetone, which is combined with the "resin" and proteins. In these experiments, in which the mixing 90 rubber: 10 sulphur was used, the maximum difference was 1·23 per cent. Kelly, working with the mixing 100 rubber: 5 sulphur, found a maximum difference of 0·49 per cent. The increased difference now recorded is no doubt largely due to the increased percentage of sulphur in the mixing.

The figures show that the amount of sulphur combined with "resin" and proteins increases with the time of cure, which is in accordance with Kelly's results.

The amount of sulphur combined with "resin" and proteins is similar for corresponding cures of the blocked crepe and rolled sheet, being slightly greater in the case of the crepe, so that the conclusions based on a comparison of the results given by the two samples are not affected whether the vulcanisation coefficient is determined by the usual method or by Kelly's method.

The results show that, in the case of these two samples, as the vulcanisation coefficient increased higher tensile strengths were obtained, but the rolled sheet could be vulcanised to a coefficient of 3·78 (Kelly's method) without perishing on accelerated ageing for 144 hours, whereas the blocked crepe perished when vulcanised to a coefficient of 3·16 and aged for the same period. The results given by these two samples suggest therefore that unsmoked sheet has a much greater latitude of cure than crepe.

The tensile strengths of the sample of wet rolled sheet at a cure giving an elongation of 860 ± 20 per cent. are distinctly below the average for the whole of the present specimens of sheet and rolled sheet, especially after ageing. On the other hand, the tensile strengths of the blocked crepe sample are a little greater than the average for the whole of the crepes. Nevertheless, it will be seen that for similar vulcanisation coefficients and the same periods of ageing the tensile strengths of the rolled sheet sample are a little greater than those of the blocked crepe.

It is of interest to note that the same period of ageing effects a similar decrease in the elongation at constant load of both samples independent of the degree of cure. The decrease in elongation effected by accelerated ageing for 144 hours is similar to that brought about by increasing the time of vulcanisation by about 25 per cent.

Alteration in vulcanisation coefficient on ageing.

An experiment was also made with the two samples Nos. 1080 and 1089 to determine whether the decrease in elongation during ageing was caused by further combination of rubber and sulphur. Weighed quantities of the vulcanised samples were aged for 144 hours at 70°C and the vulcanisation

co-efficients then determined in comparison with those of the "unaged" material by oxidation after acetone extraction. The results are as follows:—

Sample No.	Form of Rubber.	Time of Vulcanisation.	Vulcanisation Coefficient. Before Ageing.	After Ageing 144 hours at 70°C.	Increase.
		(mins.)			
1080	Blocked crepe . .	85	2·67	2·99	0·32
	,, ,, . .	113	4·10	4·60	0·50
1089	Rolled sheet (unsmoked)	77	3·46	3·84	0·38

In each case the vulcanisation coefficient increased by about 12 per cent. This is similar to the results found by other investigators and may account for a decrease in elongation at definite load of about 70 units, out of a total decrease of 170 to 180 units. The remainder of the decrease is evidently due to some other cause.

Summary.

(a) *Control samples (air-dried crepe and air-dried unsmoked sheet.)*—In the case of each of the four estates the control samples of unsmoked sheet were a little stronger than the corresponding crepes made from the same bulked latex and vulcanised to the same standard.

On accelerated ageing for 48 hours the tensile strength of the sheets showed a marked increase, but that of the crepes only increased slightly. There were considerable differences in the tensile strengths developed on ageing by the sheets from the different estates but the crepes were more uniform.

The sheets did not commence to weaken rapidly until aged for 144 hours, but the crepes rapidly weakened after ageing for 96 hours.

(b) *Effect of blocking crepe and rolling up sheets containing varying amounts of moisture.*—Blocking the crepe and rolling up the sheets had no effect on the ageing properties of the vulcanised product, nor had variations in the amount of moisture present.

(c) *Effect of degree of vulcanisation.*—Experiments on single samples of rolled sheet and blocked crepe showed that:

(1) as the vulcanisation coefficient increased, the samples became stronger but weakened more rapidly on ageing.

(2) even when vulcanised to a distinctly higher coefficient the rolled sheet deteriorated more slowly than the blocked crepe.

(d) *Comparison of unsmoked sheet and crepe.*—The results of the investigation indicate that unsmoked sheet has the following advantages over crepe when vulcanised in a rubber-sulphur mixing:—(1) Better tensile strength, (2) retention of good tensile strength for a much longer period after vulcanisation and (3) a greater latitude of cure.

On the other hand it has been shown in previous reports that unsmoked sheet is less plastic than crepe and more variable in time of vulcanisation.

Comparative ageing tests are now in progress with smoked sheet and fine hard Para.

BAMBOOS FROM MALAYA FOR PAPER-MAKING.

The Malay Section of the British Empire Exhibition, 1925, contained many interesting minor forest products, a number of which were sent to the Imperial Institute for examination. Two bamboos, which were included in the collection, have been investigated in order to determine their suitability for the manufacture of paper-pulp, and the results are given in the following pages.

The question of utilising bamboos for paper-making has been carefully considered in a number of British and foreign countries in recent years and an article summarising the general position has been published in this BULLETIN (1920, **18**, 403). Since that date an East African bamboo (*Arundinaria alpina*) has been investigated at the Institute as a paper-making material (see this BULLETIN, 1922, **20**, 458). The experiments so far made both in this country, in India and elsewhere, have clearly proved that high-class paper can be produced from bamboo-pulp, and special processes have been devised to reduce the hard nodes, which at one time presented some difficulty. Most bamboos make rapid growth and if a proper system of rotation-cutting is adopted, culms can be collected from a given area for a period of thirty years or more. Bamboos are thus particularly suitable for cultivation and in this respect offer many advantages over spruce and other pulp-woods.

The two Malayan bamboos examined do not appear to have been investigated previously and although no particulars are available at the Institute as to the quantity which could be extracted from the forests, the results recorded will be of interest as indicating the quality of the material, and will be of value if the cultivation of the bamboo for paper-making should be undertaken in Malaya.

The bamboos were described by their native names of "Buloh Plang" and "Buloh Kasap." Ridley (*Flora of the Malay Peninsula*, Vol. V) refers to two species under the name "Buluh Plang," viz. *Gigantachloa Wrayi*, Gamble, and *Schizostachyum Zollingeri*, Steud. The latter is a slender species and as the material received consisted of pieces of culms 3½ in. in diameter it is most likely that it was derived from *G. Wrayi*. "Buluh Kasap," according to Ridley is *Ochlandra Ridleyi*, Gamble, a reed-like bamboo, which attains a height of about 20 ft.

No. 1. "*Buloh Plang.*"—The sample consisted of three portions of pale yellowish-brown stems, about 2½ to 4 ft. in length and approximately 3½ in. in diameter. The distance between the nodes varied from 17 to 23 in.

No. 2. "*Buloh Kasap.*"—The sample consisted of portions of younger stems, pale greenish-yellow to pale yellowish-brown in colour, 2½ ft. in length and varying in diameter from ½ to 1 in. The distance between the nodes was upwards of 28 in.

Chemical examination of the samples gave the following results :—

	Buloh Plang. Per cent.	Buloh Kasap. Per cent.
Moisture	11·1	9·8
Ash	3·5	4·2
Cellulose, in material as received	50·0	49·75
Cellulose, expressed on moisture-free material	56·25	55·1

The lengths of the ultimate fibres were as follows :—

	Buloh Plang. mm.	Buloh Kasap. mm.
Maximum	3·6	4·2
Minimum	1·4	1·0
Mean	2·4	2·3

The crushed stems were treated with caustic soda under conditions similar to those employed for the production of

paper-pulp on a commercial scale, with the following results, which are expressed in each case on the material as received :—

	Caustic Soda used.		Conditions of Digestion.		Parts of Caustic Soda consumed per 100 parts of stems.	Yield of Dry Pulp.	
	Parts per 100 parts of stems.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
			Hours.	°C.		*Per cent.*	*Per cent.*
Buloh Plang ..	20	4	7	160	11·5	41	36
Buloh Kasap..	20	4	7	160	11·9	39	35

Under these conditions of treatment a well-reduced pulp was obtained in each case. The pulp from Buloh Plang furnished a strong, light brown paper ; it bleached fairly readily to a pale cream colour and the bleached pulp yielded an opaque paper of good strength and quality.

The pulp obtained from Buloh Kasap furnished a strong, rather paler paper ; it bleached readily, yielding a white opaque paper of good strength and quality.

The foregoing results show that both Buloh Plang and Buloh Kasap yield paper-pulp of excellent quality, with the general characteristics of bamboo pulp. The yield of pulp from both samples was fairly good, being superior to that obtained from the East African bamboo (*Arundinaria alpina*) although somewhat lower than that given by some of the Indian bamboos, such as *Bambusa Tulda*.

The pulp produced from the younger stems represented by the sample of Buloh Kasap bleached more readily than that derived from the older Buloh Plang, but both materials would be quite suitable for the commercial production of paper-pulp of high quality.

A NEW KINO FROM TANGANYIKA.

A sample of kino obtained from Usoke, Tabora District, Tanganyika, and derived from " Mninga " (*Pterocarpus Bussei*), was received for examination in November 1925. It was stated that the material had been collected from trees felled in clearing for sleeping sickness segregation camps.

P. Bussei is the most important timber tree of the Savannah forests of Tanganyika. Although the individual trees are scattered, as is typical of this kind of forest, the aggregate quantity of timber is stated to be great. The wood is reddish-brown, light in weight and easily workable.

The material received consisted of small, glistening, ruby-red, brittle grains with an astringent taste, resembling Malabar kino (derived from *Pterocarpus Marsupium*) in appearance and properties, except that it was of somewhat paler colour.

On examination the material furnished the following results which are compared with those obtained by Hooper for nine samples of Malabar kino (*Yearbook of Pharmacy*, 1900, p. 148):—

	Tanganyika Kino. *Per cent.*	Malabar Kino. *Per cent.*
Moisture	9·7	12·2 to 15·7
Insoluble matter	0·7	0·4 to 5·1
Extractive matter (non-tannin)	12·9	1·1 to 11·5
Tannin	76·7	70·0 to 82·4
Ash	1·5	1·0 to 2·3
Tintometer readings—Red	3·0	—
Yellow	3·8	—

These results show that the present material is of similar composition to ordinary Malabar kino. It also complies with the following requirements of the British Pharmacopœia for kino derived from *Pterocarpus Marsupium:* "Almost entirely soluble in 90 per cent. alcohol. Slowly and incompletely soluble in cold water, not less than 75 per cent. soluble in boiling water, the solutions being deep red in colour. Almost entirely insoluble in ether. An aqueous solution (1 in 20) yields a voluminous reddish precipitate with dilute mineral acids, and when largely diluted with water a greenish-black precipitate with test solution of ferric chloride. Ash not more than 2·5 per cent."

A specimen of the kino was submitted to wholesale druggists, who reported that it was of good quality and would find a regular market. They stated that they could probably dispose of about 10 tons per annum if consignments equal in quality to the sample could be supplied and provided that they were the sole distributors. The firm regarded the kino as worth about 1*s.* 3*d.* to 1*s.* 6*d.* per lb. c.i.f. London, and offered to receive a trial consignment of 5 cwts. at a price of 1*s.* 5*d.* per lb.

to test the market both in the United Kingdom and in other countries. This would enable them to form a definite opinion as to the quantities which they could purchase annually.

Remarks.

This product obtained from *Pterocarpus Bussei* is a form of kino closely resembling the ordinary Malabar kino derived from *P. Marsupium*. Although containing a large proportion of tannin, kinos are not employed for tanning as they are much more valuable for medicinal purposes. The present material could not be sold as "Kino B.P." as the Pharmacopœia specifies the product of *P. Marsupium*. It is, however, of excellent quality and would be saleable for pharmaceutical use in cases in which the official kino is not demanded.

It was suggested that if the kino is available in sufficient quantities it would be desirable to forward a trial consignment of 5 cwts. in order that the commercial possibilities may be fully investigated.

ARTICLE

MACHINERY FOR USE IN THE PALM OIL INDUSTRY.

SINCE the previous article on machinery used in the palm oil industry was published in this BULLETIN (1917, **15**, 57), great advances have been made in the design of machines suitable for the preparation of palm oil and improvements have been effected in those used for cracking the nuts.

The chief factor responsible for the increased interest that has been shown during recent years in these questions has undoubtedly been the starting of the cultivation of the oil-palm on an extensive scale in the Dutch East Indies, and the general use on the plantations of machinery for the preparation of the products. This new source of oil-palm products may have a serious effect on the West African trade in palm oil and palm kernels, and it is only natural, therefore, that those interested in the development of West African countries are considering various possible improvements in the industry, including the establishment in suitable localities of central factories equipped with modern machinery

in order to obviate the wasteful methods of preparation now employed by the natives and to improve the quality of the palm oil obtained. These questions, as they relate to British West Africa, were recently considered by a Committee appointed by the Secretary of State for the Colonies and their recommendations were summarised in this BULLETIN (1925, **23**, 358).

The most important improvements that have been made during the last ten years in the preparation of oil-palm products consist in the sterilisation of the fruits as soon as possible after collection and in expressing the oil from the pericarp by centrifugal extractors. The desirability of obtaining palm oil of good quality and containing as little free fatty acid as possible led to experiments, particularly in Sumatra, to ascertain the cause of the acidity and the means of preventing it with a view to obtaining an oil which would be suitable for edible use after a minimum of refining. These experiments demonstrated clearly that if the fruits are submitted to steam heat (i.e. sterilised) for a short period as soon as possible after being gathered, the resulting oil contains a low amount of free fatty acids provided that the remaining processes of preparation are conducted with reasonable care.

Prior to the introduction of centrifugal extractors, hydraulic presses had been generally used in factories for expressing the oil from the pulp (or pericarp). Although such presses are satisfactory when worked under European supervision, it was found that they were troublesome when used under conditions prevalent in West Africa. The introduction of centrifugal extractors, however, has given very satisfactory results. In some plants the pericarp is removed from the nuts before being centrifuged. This allows a larger amount of pericarp to be put into the baskets, but it is claimed by some that the oil is not so thoroughly removed as when the whole fruits are treated.

Another improvement of value, although perhaps of not quite such great importance as either of the above, is the heating of the nuts by steam after the removal of the pulp. This treatment causes the kernels to shrink slightly from the shells whereby on cracking fewer broken kernels are obtained and the kernels come away with much less shell adhering.

A problem which is at present engaging considerable attention is the designing of a machine that will efficiently separate the kernels from the broken shells by a dry method after the nuts have been through the cracking machines. In many factories the kernels are separated from the broken shells by means of a brine bath in which the former float and the latter sink. Although the separation is satisfactory, the cost of the necessary salt to replace that lost in the process is considerable in West Africa and accordingly many factories use a suspension of clay in water. Both these methods, however entail a subsequent drying of the kernels before being bagged and of the shells before being used as fuel for the boilers, and a method of separation which does not involve the use of water is therefore very desirable.

Power Machinery.

With regard to the equipment of central factories there are a number of firms, both British and foreign, who manufacture complete plant for the preparation of palm oil from palm fruits and for cracking the nuts. A plant for this purpose, manufactured by Manlove, Alliott and Co. Ltd., Nottingham, which is capable of dealing with two tons of fruits per hour was exhibited at the British Empire Exhibition in 1924. Similar plants by the same firm are at present operating in Nigeria and the Federated Malay States and one is in course of erection in the Belgian Congo. According to the method employed, the fruits on delivery at the factory are sterilised to destroy the enzymes and thereby to prevent a high free fatty acid content in the oil. The steriliser consists of a vertical cylindrical vessel fitted with an internal steam sparge pipe which permits of the fruits being subjected to direct contact with live steam. A factory would be equipped with three or more of these sterilisers into which the fruits are delivered by means of an elevator. After sterilisation the fruits are transferred into the digester, a steam-jacketed cylindrical vessel fitted internally with agitators and constructed to work under steam pressure. In this vessel, holding from 20 to 30 cwts., the fruits are heated by live steam under pressure for 20 minutes, while being agitated by means of the revolving arms. The agitation removes the major portion of the pericarp which has become saturated with water by means of the steam introduced and

also liberates the oil from the oil-cells and renders it readily extractable. The cooked fruits are discharged down a shoot into the basket of the centrifugal extractor, each basket holding from 6 to 7 cwts. During the filling of the baskets, a certain amount of oil and water drains away through the extractors into the oil-receiving tank. When full, the extractor is closed and the basket and its contents are centrifuged for 15 to 20 minutes, live steam being introduced to increase the flow of the oil. By this process oil and water are removed and run away into the receiving tank. At the end of the extraction the remaining pericarp waste should contain not more than 3 per cent. of oil. Two or more centrifugal extractors are necessary for operating in connection with each digester to ensure continuity of working. The receiving tank in which the mixture of oil and water is collected is divided into a number of compartments to facilitate the separation. The oil thus separated is found to contain from 8 to 10 per cent. of water and from 1 to 2 per cent. of dirt, both of which must be removed without loss of time to produce the highest quality of oil. The oil is therefore washed with water in order to remove as much as possible of the solid impurities and is then passed through a mechanical purifier or separator which removes the balance of the dirt and practically all the moisture. Such a purified oil rarely contains more than 0·4 per cent. of moisture and is free from dirt.

On stopping the extractors, the basket is taken out by means of a pulley and tackle and placed on a stage above a rotary drier. Here the contents of the basket, consisting of pericarp waste and nuts, are removed by manual labour into the hopper of the drier. In this machine, consisting of a cylindrical vessel, 30 feet long, the nuts and pericarp waste are dried by a current of hot air or by waste gases from the boiler fires, which are sent through a dust collector before being driven by a fan into the drier. The dried material is elevated into a large hexagonal rotating screen, constructed of bars at such a distance apart as to allow the waste to pass through while retaining the nuts. The waste is fed to the boiler fire and the nuts are transferred mechanically into an autoclave where they may be steam-heated if necessary to cause the kernels to shrink away from the shells and become

more readily separable. In many cases, especially with thin-shelled nuts, the drying in the rotary drier is sufficient for this purpose. The nuts are passed by a spiral conveyor and elevator to the cracking machines, of which there are two. The cracking machine, with a capacity of one ton of nuts per hour, is of the centrifugal type and consists of a central rotor revolving at a high speed. The nuts fall from the hopper through the axis of the machine and are thrown to the periphery with considerable force where they impinge upon a cast-iron casing and are cracked. The mixture of broken shells and kernels falls on to a rocking screen which removes any unbroken nuts while allowing the shells and kernels to pass through into a brine bath, in which the kernels float and the shells sink. The kernels are transferred by means of a wire skimmer to a draining board, the shells being conveyed away mechanically from the bottom of the bath. Adhering brine is removed from the kernels and shells by means of a centrifuge, the separated brine returning to the bath. The kernels are then ready to be bagged for export.

A demonstration given at the British Empire Exhibition showed that this plant worked efficiently and the process was automatic except as regards the filling and emptying of the centrifugal baskets and the removal of the kernels from the brine bath. Experience with a plant of this type in the Federated Malay States has proved that the yield of oil is equal in every respect to that of the more expensive pressing installations and that the operating costs and overhead charges are considerably lower. From fruit containing 30 per cent. of oil, 26 per cent. was obtained.

The plant manufactured by the Planters Engineering Co. Ltd., London, works in a similar way to that above described. The oil obtained is mixed with hot water and passed through an Alpha Laval purifier which is included in the plant and in which the water and the impurities are separated centrifugally from the oil. Provision is made for the pericarp waste after separation from the nuts to be reheated and returned to the centrifugal extractors if it still contains sufficient oil to make such re-treatment remunerative. Before the nuts are cracked, the smaller ones are separated by screening from the larger ones and are cracked separately

as they require the machine to be run at a faster speed to ensure the most efficient results. The kernels and broken shells are separated by a clay suspension in water in a machine which was originally designed for diamond mining and which is considered to be far superior to the type of separating machine consisting of a tank with a liner. The kernels are finally washed by spraying with water in a circular revolving screen, dried in the sun, and sieved to remove dirt and extraneous matter.

Further plant was exhibited at the British Empire Exhibition in 1924 and 1925 by Culley Expressors Ltd., London. According to their process the fruits are carried by an elevator to the sterilising tank where they are treated with steam for 20 to 30 minutes without agitation. After sterilisation the fruits pass down a shoot to the depericarping machine. This machine consists of a cylinder, five feet in length, built up of a number of discs having a flange surfaced with stabbed metal, each disc being slit and bent to form one turn of a helix. Between each pair of discs project short springs. The fruits are introduced into the hopper and pass through longitudinal channels in a cover which extends along the whole length of the cylinder, the projecting springs assisting the progress. In the course of the travel through the channels the pericarp is rubbed off by the abrading surface of the revolving cylinder and falls on to an endless travelling band. A wire brush is provided which removes any adhering pericarp from the surface of the cylinder. The pulp is conveyed by the travelling band into the baskets of the centrifugal extractors and centrifuged for fifteen minutes, whereby the oil is removed, steam and hot water being introduced if necessary to assist its liberation. At the expiry of this period the machine is stopped, the basket removed and the pericarp waste emptied out. The extracted oil runs away into a tank and is then purified by being passed through a de Laval separator. The pericarp-free nuts travel automatically to a large cylindrical desiccator where they are dried by steam heat for 2½ hours in order to cause the kernels to shrink away from the shells and thereby facilitate their separation. The nuts are then allowed to fall into the cooling bin. Before being introduced into the cracking machines, the nuts are automatically graded, the extra small and the extra large nuts being collected

and cracked separately. The medium small nuts pass into one cracking machine and the medium large ones are cracked in the second machine. A machine is stated to have been devised by this firm for separating the broken shells from the kernels by a dry method.

It is claimed for this plant that 80 per cent. of the available palm oil is removed from the pericarp in the centrifugal extractors and it is expected that under factory conditions the yield will be increased to 85 per cent. Oil can be obtained within 20 minutes from the time when the fruits leave the sterilising tank. The efficiency of the nut-cracking machine is 98 per cent. The demonstration given at the British Empire Exhibition showed that by means of this plant palm oil apparently of good quality can be readily prepared ; the fruits were completely depericarped and the nuts were satisfactorily cracked, only a very small percentage of the kernels being chipped or broken. The labour required for a plant to treat ten tons of fruits per day is stated to be one European and four natives.

Rose, Downs and Thompson, Ltd., Hull, are also makers of complete plant for the preparation of palm oil and for cracking palm nuts, but as this firm are now engaged upon the re-design of their plant, no details of their process are given in the present article.

In the process recommended for use with plant manufactured by Greenwood and Batley, Ltd., Leeds, the fruiting heads are sterilised and not the fruits alone as is the case with the plants previously described. In small factories the sterilised heads are usually stripped by hand but in larger plants the stripping is effected mechanically in a machine consisting of rapidly revolving corrugated rollers on which the heads are allowed to drop intermittently. By contact with the rollers the fruiting heads are revolved and the fruits thrown off by centrifugal force and drop between the rollers. The fruits are then delivered into screens in which the small pieces of stalk, etc., are removed, the main stalks being retained by a grid and periodically ejected. The stripped fruits are elevated into a mashing kettle (or digester) which is steam-jacketed and fitted with suitable stirring and beating gear by which the pericarp is thoroughly bruised and in large measure

removed from the nuts. From the digester the cooked fruits are delivered to the presses, which are of the swing-box type. Each press has two perforated cages capable of revolving round one of the columns, one cage being emptied while the material in the other is being pressed. The press-cakes are placed in an octagonal rotary sieve to separate the pericarp from the nuts. In small plants this sieve works intermittently but in the larger ones screening is continuous, the cake being fed in at one end and the clean nuts passing out at the other.

It is claimed that by using the above presses about 80 per cent. of the oil can be obtained and in many cases no further treatment of the pericarp is carried out. By means, however, of a second pressing in cage presses using a very high pressure, the yield of oil can be raised to about 96 per cent.

The crude oil from the presses is pumped into a boiling pan of special construction for bringing the oil rapidly to the boiling point. After boiling, the oil is discharged into one of a group of sedimentation tanks, from which, after settling, the clear oil is drawn off from the top by displacement and passed through a filter press of usual construction to remove the remaining small amount of dirt, or it may be purified by means of a super-centrifuge.

The nuts as they leave the rotary sieve pass to a grading screen, which separates the large nuts from the small ones. These nuts are then cracked, each grade separately. The cracking machine consists of a drum rotating at a high speed, into the centre of which the nuts are introduced. They leave the drum through radial ports and are flung against the inside of the surrounding casing with sufficient force to break the shells without damaging the kernels. The mixture of shells and kernels are screened to remove the smaller pieces of shell and any unbroken nuts, the remaining shells being separated by means of a brine bath or clay suspension. In the larger plants, automatic recovery of the shells from the bottom of the bath and automatic skimming of the kernels from the surface are adopted. The kernels are afterwards washed and dried.

The methods chiefly employed on the East Coast of Sumatra are similar to those just described. The design of the threshing machine, however, in which the fruits are separated from the sterilised bunches is different. In this machine the fruits

are removed by means of revolving beating arms which throw the bunches round at a quick rate. The spaces between these striking arms are so arranged that the stalks of the bunches cannot pass through but only the fruits. Small calyxes and other small extraneous matter are then removed from the fruits by a current of air or by screening. In a few factories the pericarp is given a second pressing, and in one it is extracted by a solvent to recover a further amount of oil. The depericarped nuts after screening are placed in a perforated horizontal cylinder through which hot air or exhaust gases are passed. On rotating the cylinder the nuts are cleaned by rubbing against one another. The cracking machines used are of either the centrifugal or roller type. For the former it is better to grade the nuts before cracking them whereas for the roller type no grading is necessary, but the nuts should be stored for some time before cracking to allow the kernels to shrink sufficiently to prevent their being broken. The kernels, after being separated from the broken shells by means of a suspension of clay in water, are washed and dried to a moisture content of from 5 to 6 per cent, and are then packed.

A machine for depericarping the fruits, made by Sigg and Jacquard, Paris, consists of a horizontal cylindrical drum, the rotating axis of which is fitted with arms whose ends are connected by chains. The drum is hinged at the bottom to allow of its being opened. The sterilised fruits are introduced into the drum through the hopper and the beating arms which remove the pericarp are rotated at 500 revolutions per minute for from ten minutes to an hour, the time varying with the nature of the fruits. At the end of the period of revolution a slide at the bottom of the machine is opened and pericarp-free nuts fall out leaving in the drum the pericarp still containing some nuts. More fruits are introduced into the machine and the process is repeated until the machine is full of pericarp, which is then removed by means of a spade. The material is transferred to kettles where it is warmed with water and is then pressed in a screw press of a horizontal type. The nuts remaining in the press-cake are separated by a hexagonal screen rotating at 35 revolutions per minute, the nuts being left inside while the pericarp falls through the meshes. This pericarp is warmed again with water and re-pressed to

give a further quantity of oil. After the second pressing the pericarp waste contains 7 to 8 per cent. of oil (calculated on the dry material). The mixture of oil and water expressed is heated in a kettle to destroy any emulsion formed, the water is separated and the oil filtered through canvas bags. Trials with this plant have been moderately successful. Fruits from Africa which had become dry through being kept were satisfactorily depericarped but the separation of the nuts in the screen was not complete. Fresh fruits from Indo-China did not yield such good results, the depericarping being very difficult and the meshes of the screen constantly becoming choked with pulp. The working of the press is much easier than that of vertical presses but it has the disadvantage that the material in the press has a tendency to become more compact in the lower half of the press so that an unequal pressure results. The makers of the plant are endeavouring to rectify these faults. The method of filtration through canvas bags appears rather primitive and slow. This firm has erected a plant at Lisafa, Belgian Congo, in which the palm oil is extracted by means of trichlorethylene.

According to the patented processes of Moseley, Dyke and Lever Bros., Ltd., palm fruits are submitted to a preliminary cooking to loosen the pericarp. This may be accomplished by placing the fruits in closed vessels and allowing anaerobic auto-fermentation to take place when the temperature of the mass reaches 60°C. By this means, however, an undesirable increase in the acidity of the oil is produced. A better method is to heat the fruits rapidly in an autoclave with steam under pressure. This latter method has the advantages not only of sterilising the fruit and avoiding the formation of free fatty acids, but also of causing the kernels to become detached from the shells whereby the subsequent process of cracking the nuts is facilitated. The pericarp may be removed from the fruits by the use of a ball-mill but it is preferred to carry out this operation in a specially constructed apparatus. This consists of a cylindrical kettle, 4 ft. in diameter and 4 ft. 6 in. high, having two sets of four fixed radial arms, and three pairs of radial arms rotating on a central shaft. The bottom of the kettle is perforated with slits 3 in. long and ¼ in. wide, while into the top of the vessel is fitted a pipe through which water may be sprayed on to the material within.

From 12 to 16 cwts. of cooked fruits are transferred to the kettle, together with from 13 to 18 gallons of water, the temperature of the mass being preferably 85°C to 90°C. The central shaft is rotated at about 40 revolutions per minute; the pericarp is removed through the attrition of the fruits against one another, and almost immediately begins to fall through the slits in the perforated bottom. This separation is facilitated after the first five minutes by further additions of water, care being taken that the total quantity of water used does not exceed 50 per cent. of the weight of the fruits The operation takes half an hour from the time the material is introduced into the kettle. By this means the nuts are obtained practically free from fibre. The mass of separated pericarp is treated in a centrifugal machine, having a closed basket, when the oil and water are liberated and drained away and are subsequently separated from one another by any of the customary methods. The pericarp waste is left behind in the machine. In order to complete the cleavage between the kernels and the inner surface of the shell the depericarped nuts are subjected to a rapid rise in temperature to about 143°C. by being fed into an autoclave and heated by hot air or steam at about 40 lb. pressure. After cooling, the nuts are cracked in a machine of the usual type, and it is found that, owing to the treatment in the autoclave, the kernels come away from the shells practically whole and undamaged. After screening to remove dirt and unbroken nuts, the kernels are separated from the shells by any of the usual methods, but preferably by means of a flotation process in which a suspension of clay in water is employed.

The Pericarp Syndicate Ltd. and E. W. J. Trevor have patented a process in which the bunches of fruits are sterilised by heat and the fruits separated. This method has been summarised as follows. The fruits are depericarped in a machine comprising a series of bars arranged on the surface of a cylinder or on a belt capable of rapid motion through a chamber arranged at one side of the path of the bars and containing the fruits. These bars co-act with a baffle board which is adjustable vertically and in inclination, being hinged to a plate which is secured by bolts passing through slots. The fruits are stirred and fed forward by projections on an

endless belt. The separated pulp is pressed in hydraulic presses and the oil heated with water by a closed steam coil whereby heavy impurities are precipitated.

Établissements A. Olier, Paris, make a depericarping machine in which two endless bands furnished with points tear away the pulp from the fruits which are brought to them by a distributor from the hopper. The fruits should have previously been heated at 100°C. to sterilise them and to soften the pericarp and facilitate its removal. The machine also separates the nuts from the liberated pulp, and the pericarp is pressed hydraulically in the usual manner. The cracking machine of this firm does not work on the centrifugal principle. It consists of a member shaped like two cones placed base to base, mounted on an axle. On either side of this central member is placed a disc thicker at the bottom than at the top, whereby the distance between the disc and the central member is less at the bottom than at the top. The surfaces of the discs and the central member are grooved concentrically and the latter is also furnished with radial grooves. The nuts are fed in through the hopper, the feeding being controlled by means of suitable mechanism so that not more than two nuts are delivered at a time into the space between the central member and the discs. As the central member rotates the nuts are carried round and on entering the narrower spaces between the discs and the central member are cracked, the pieces falling into a receptacle beneath.

Power-driven Nut-cracking Machinery.

In addition to the above-mentioned complete plants for the preparation of palm oil and the cracking of the nuts, a number of firms specialise in cracking machines only.

The "Rapid" machine made by the Vegetable Oil Machinery Syndicate Ltd., Manchester, works on the centrifugal principle, has a capacity of 18 cwts. of nuts per hour and gives an efficiency of 94–95 per cent. Only 2 per cent. of the kernels are broken and these only to a slight extent. A ¾-h.p. engine is required to drive this machine, which comprises a drum rotating at 1,000 revolutions per minute to the centre of which the nuts are fed from the hopper. The nuts are discharged by centrifugal force through two ports in the drum against

a number of beaters fitted to a large disc, which rotates at the same speed as the drum but in the opposite direction. The projected nuts strike against the beaters with great force and the shells are broken. The nuts should be screened from loose pericarp and graded before being cracked.

This firm also manufactures a machine for separating the shells from the kernels by a dry method. This method has the advantage over the usual method in which brine or a clay suspension is employed that the kernels do not undergo any deterioration through contact with water. Into the hopper of this separating machine the mixture of kernels and broken shells is delivered either by hand or mechanical elevator. An agitating feed slide ensures an even feed of the material across the whole width of the machine, which consists essentially of four screens together with a contrivance for producing an air blast. The material passes first to the top screen which removes all unbroken nuts and the larger pieces of shell. The second screen also separates large pieces of shell while the bulk of the material passes through and falls on to the third screen, the mesh of which is sufficiently small to keep back the kernels and to allow the smaller pieces of shell to fall through. The kernels then pass to the bottom screen, which is similar to the third, and are discharged from it in a thin even stream into a strong vertical blast, which is intended to blow away any pieces of shell not removed by the screens. Throughout the operation a combined lifting and reciprocating motion is applied to the screens. An air regulator is fitted to the blower to regulate the force of the blast. The machine is supplied with a set of screens of different meshes to suit different sized nuts. A 5-h.p. engine is required to drive this separator.

A demonstration of the working of these cracking and separating machines recently given showed that the cracking was satisfactory, only a very few kernels being damaged. The separating machine may be considered as being fairly efficient in view of the difficult nature of the separation involved. The very small and the flat kernels are apt to be lost by removal with the small pieces of shell while the separated kernels are not entirely free from shell. The machines used for the demonstration have been purchased by a commercial firm and are being shipped to the Gold Coast.

The "Rotocrac" machine made in Amsterdam consists of two cast-iron discs with a number of radial projections on one face of each. The discs are mounted side by side on horizontal axes which are parallel but arranged eccentrically. The projections on the face of one disc fit in between those on the other and owing to the arrangement of the axes the V-shaped spaces thus formed between the projections on the two discs vary in size as the discs revolve. The nuts are fed in from the hopper and allowed to fall one at a time by means of a controlling mechanism between the interacting projections when they are at their maximum distance apart. The discs rotate at the same rate. The nuts are broken by the pressure exerted upon them as the projections approach one another. At the bottom of the cycle, the interacting projections withdraw slightly from one another and the broken shells and the kernels fall into a receptacle placed beneath the machine. The power required to drive a machine with a capacity of 88 lb. of nuts per hour is ¼ h.p.

The "Formod" nut-cracking machine has been constructed by Noël frères (Société des Forges modernes de Bordeaux), with a view to lightness, simplicity and compactness. It is made in two sizes; the smaller, weighing 72 lb., has overall dimensions of 16 in. × 16 in. × 10 in. and can deal with about 4 cwts. of nuts per hour. The larger machine weighs 121 lb., has dimensions of 28 in. × 20 in. × 14 in., and its capacity is correspondingly greater. The essential parts of these machines are a grooved cylinder and a grooved plate set at an angle of 45°. The opening between these can be regulated by two bolts to suit any size of nut. By turning these bolts, the distance of the cylinder from the plate can be readily altered. The nuts fall between these two members and are forced between them by the rotation of the cylinder and thereby are cracked.

The main feature of a machine manufactured by Rose, Downs and Thompson Ltd., Hull, is a drum, with a wide channel along one diameter, which is rotated at a speed of 1000 to 1300 revolutions per minute inside a surrounding casing with an inlet on one side at the centre and an outlet at the bottom on the other. The nuts are fed into the channel

in the drum and are flung out of it by centrifugal force against the inside of the casing where they are cracked, the broken shells and kernels falling through the outlet at the bottom of the casing. This machine can treat 3 to 4 tons of nuts per hour and absorbs from 2 to 2½ horse-power.

The "Delta Junior" machine (Pratchett Bros., Carlisle) can deal with 1 ton of nuts per day, requires 1½ h.p. and has an efficiency of 98 per cent. The nuts are broken by centrifugal force in this machine also, the necessary motion being imparted to the nuts by means of a circular member resembling a paddle-wheel which rotates at 1000 revolutions per minute and round the periphery of which are fitted a large number of flat blades on which the nuts fall and by which they are flung against the outer casing. The rate at which the nuts fall can be regulated by means of a slide at the bottom of the hopper. This machine was exhibited at the British Empire Exhibition in 1924.

A machine of type similar to that of Rose, Downs and Thompson, Ltd., is constructed by Egrot et Grangé, Paris, and contains a few modifications of details with a view to increasing the output and the efficiency. The channel in the drum instead of being the same width throughout is twice as wide at the middle as at the ends, and thereby the output is increased. The other modification is in the shape of the casing. In order to avoid the kernels rebounding on to the revolving drum and becoming broken the casing is made in the shape of a truncated cone the wider portion being on the outlet side. This model has a capacity of 1½ tons of nuts per hour and requires ¾ h.p.

Hand Machinery.

For use by the natives in localities where no central factories exist, several firms manufacture machines to be driven by hand. Manlove, Alliott & Co. Ltd., Nottingham, make a small hand-power plant operating similarly to their large power-driven one (described on page 225) with the exception that in the former the nuts are separated from the fibre by hand and are dried naturally preparatory to being cracked. They have supplied a large number of these machines to the Belgian Congo with satisfactory results.

Hand Depericarping Machines.

Nut Oils Ltd., London, sell a simple depericarping machine invented by J. O. Drews, a model of which was exhibited at the Rubber and Tropical Products Exhibition in London in 1921. This machine consists of a horizontal iron cylindrical drum, about 3 ft. long and 1½ ft. in diameter, with a removable lid and an outflow lip. In this drum is fitted axially a rotatory shaft with beating arms radiating therefrom about 2 in. apart and in different planes, and to the ends of which rings are attached. Water and fruits are placed in the drum and heated for about 15 minutes by a fire underneath. During the heating, the shaft with the beating arms is rotated by hand whereby the pericarp is removed from the nuts, and the continued heating and agitation liberates the oil. On withdrawing the fire and allowing the liquid to settle, the oil rises to the top and the mixture of fibrous pericarp and nuts falls to the bottom. The drum is then revolved sufficiently to allow the oil and the water to escape from the opening provided. The marc is removed from the drum and submitted to pressure in a small hand-press to expel the oil and water. This machine is in reality more than a depericarper; it prepares palm oil in addition. It will be seen that the process is fundamentally the native method for the preparation of palm oil improved and modernised. The machine has the advantage of being of simple construction, of low cost to manufacture, and easily portable. Its capacity is 56 lb. for each charge. A number of these machines have been sent out to Sierra Leone and the Belgian Congo.

Culley Expressors Ltd., London, make a model of their depericarper (p. 228) for use by hand, with a capacity of 56 lb. of fruits per hour. This model is not equipped with a revolving brush to clean the abrading surface of the cylinder automatically nor with a travelling band to convey the separated pericarp. To be used in conjunction with this hand model the firm make a small hand-screw press in which the oil is expressed from the cooked pulp.

Hand Nut-cracking Machines.

Most of the firms mentioned above as supplying power-driven machines for this purpose also provide models for use by hand. These models are in general similar as regards

their working principles but vary in some minor details from the larger machines. It is interesting to note that one firm, Culley Expressors Ltd., London, have a model which is designed to be driven by means of a treadle.

In addition to the machines already described the following nut-crackers may be mentioned:—

The "Boby" machine, which is manufactured by Robert Boby, Ltd., of Bury St. Edmunds, incorporates the patent of Tarrant. It is specially designed for hand-power in order to utilise native labour. It consists essentially of a hopper, with an automatic feed and a cracking device with a stationary curved plate and a rotating roller which is made to approach the fixed member in order to break the nuts. During one revolution of the flywheel the following cycle of operations is performed. The nuts, having been placed in the hopper, are carried round in rows by a revolving drum or feed roll, to which motion is imparted from the main roller axis, the movement both of the roller and drum being intermittent. The nuts, having passed over the feeding drum, fall on to a gate, which is worked by a cam on the main shaft, and which introduces the nuts at the correct moment into the feeding chamber beneath. At the bottom of this feeding chamber is a similar gate which determines the precise moment at which the row of nuts shall fall into the cracking mechanism. Immediately this lower gate has discharged its nuts it closes. The cracking is effected between a curved plate and the roller. The latter is made to move forward or rotate slightly after the feed has been introduced, whereby the nuts are settled in their places. When this is done the upper half of the cracking plate is made to approach the roller by means of two eccentrics on the main shaft. Owing to the peculiar shape of the space between the cracking plates the nuts bed themselves down according to their size, the smaller being at the bottom. On completion of the cracking stroke the lower half of the cracking plate is made to recede from the roller and the cracked nuts fall down.

The output of this machine, when being run at 50 revolutions per minute, is stated to be 1,000 nuts per minute and its efficiency is claimed to be 97 per cent. It can also be adapted to power-driving and at the above rate of working requires about one-seventh of a horse-power. Trials carried out with

this machine are said to have shown it to be satisfactory, the kernels being delivered undamaged. It is stated that it is not necessary to grade nuts prior to their being cracked, as there is a device fitted to regulate the machine for different sizes of nuts. The principle of the machine is good but the model shown at the Rubber and Tropical Products Exhibition in 1921, weighing 10 cwts., is not easily portable and would therefore be of more use in a central factory than for transporting from one village to another.

The machine manufactured by Nut Oils Ltd., London, consists of two vertical iron plates set at an angle of 13° with one another, the inner surface of each being slightly grooved. One of these plates is fixed while the other, by means of a cam mechanism, is capable of being moved. The nuts are fed from a tray above the machine and by a distributing contrivance pass between the plates, where they are held momentarily, while a sharp blow is given them by the action of a supplementary cam upon the moveable plate. The plates then separate and the broken shells and kernels fall into a receptacle placed beneath the machine. The capacity is about 25 lb. of nuts per hour.

Trials have shown that this machine is easy to work and that it cracks the nuts very satisfactorily with an efficiency of about 98 per cent.

Another machine working on the same principle, i.e., with one fixed and one moveable plate, is made by Richard Duckering of Lincoln. It differs from the preceding in the mechanism for moving the plate and for feeding the nuts, and also in having a means of adjusting it to take varying sizes of nuts. The machine can treat about 130 lb. of nuts per hour.

Farge Buissière, Grenoble, France, make a machine similar to the Crellin machine (see this BULLETIN, 1917, **15**, 74) in which the nuts are cracked by passing between rollers. This French machine consists of two pairs of rollers. One of the upper pair has a smooth surface and the other has a spiral beading running round its whole length. This pair are set horizontally and at an angle of 4° to each other, and revolve in opposite directions, their object being to grade the nuts before they fall on to the lower pair. This lower pair, the function of which is to crack the nuts, are also set horizontally

and at an angle to one another and revolve in opposite directions. One of the lower rollers has a series of grooves round it, the size of which increases from one end of the roller to the other. The other roller, the surface of which is slightly roughened, is in the shape of a truncated cone. The nuts are fed from the regulating distributor on to the upper pair of rollers and are carried along by the spiral beading until they reach a point where the space between these rollers is sufficiently large to allow them to fall through on to the lower pair. They then travel along these cracking rollers until they are caught between them and are broken, the products falling down into a receptacle beneath. The distance between the rollers can be regulated to suit the sizes of the nuts being treated. The capacity is from 40 to 50 lb. of nuts per hour.

A machine manufactured by Lelogeais, Paris, works on the centrifugal principle and differs from other machines of this type chiefly in the form of the rotating disc and the means of power transmission. The nuts fall on to a horizontal aluminium disc fitted with four curved vanes, spaced at equal distances on its upper surface. This disc, rotating at 1,100 to 1,500 revolutions per minute, throws the nuts against projections on the inner surface of the surrounding casing, where they are cracked. The power is transmitted from the handle to the disc by means of gearing and a friction drive.

Haake's machine, made in Berlin, consists essentially of a drum, with six channels radiating from the centre, which is rotated at a speed of 1,500 revolutions per minute on a vertical axis. This drum is surrounded by a casing of square section, in the middle of each side of which is a projection. The nuts are fed into the centre of the drum by an automatic distributing device and are flung out through the channels against the sides of the casing, where they are cracked by the force of the impact. It is stated that with this machine the number of unbroken nuts is rather higher than usual, this defect being ascribed to the shape of the casing.

Conclusions.

The foregoing survey of the machines that are available at the present time for the preparation of palm oil and the cracking of the nuts shows clearly the advance that has been made in this direction during the last ten years.

The present general trend of opinion is that the most promising way to increase the output of palm oil and kernels and to improve the quality of the former is by the installation of central factories. In such factories palm oil would be prepared under expert supervision by mechanical means, with the result that a greater yield of oil from the fruits would be obtained and the quality of the oil improved.

Serious consideration will have to be given to the question of the installation of central factories in Africa, as in this direction lies one of the chief ways of meeting the threatened competition from the East. If such installations become general a large impetus will be given to the manufacture of this class of machinery, and will naturally lead to further improvements in their design and in the processes.

The future prospects of hand-machines are not so promising as of those driven by power. The hand-machines are specially designed for use by natives. Although it must be admitted that by their use the yield of palm oil and kernels is increased and the quality of the oil improved, yet it is doubtful whether for some years to come the natives will adopt these mechanical aids.

The use of nut-cracking machines would enable the natives to prepare their supplies of kernels with less labour, but this does not appeal to them, as the supply of labour is ample for the purpose, the work being usually carried out by the women and children.

NOTES.

Prickly Pear Control in Australia. The necessity for adequately controlling the spread of the prickly pear in Australia is becoming increasingly urgent. The two species most destructive are *Opuntia inermis*, and *O. stricta*. It was estimated in 1919 that the pest was spread over some 23,000,000 acres of land in Queensland and New South Wales, and that it was extending at the rate of 1,000,000 acres a year. Various mechanical methods of destroying the plant have been tried without much success, and although poisoning with arsenical compounds has given good results, and is suitable for clearing scattered pear on pastoral land or dense pear on valuable land, it is too expensive to be utilised for the destruction of the pest on great densely covered areas of land of comparatively low

value. Unfortunately it is just lands of this kind which form the chief centres for the distribution of the plant. As far back as 1914, it was suggested that some of the natural enemies which keep the pest in check in America, its native country, should be introduced into Australia, and in 1919 a scheme for investigating the possibilities of acclimatising certain insects and fungi known to be inimical to prickly pear was prepared by the Commonwealth Institute of Science and Industry. Towards the cost of the scheme the Commonwealth Government agreed to contribute £4,000 annually for five years and the Governments of Queensland and New South Wales £2,000 each annually for the same period. A Commonwealth Prickly Pear Board was appointed to control the expenditure and the business side of the investigation. An account of the work undertaken during the first four years of operation under the scheme (from June 1920 to June 1924) has been published as *Bulletin No.* 29 of the Commonwealth Institute of Science and Industry (*Natural Enemies of Prickly Pear and their Introduction into Australia*, by W. B. Alexander).

Investigations were made by officers of the Board in the United States (mainly in Texas and Florida), in Mexico and in Argentina. As a result a number of insects have been sent to Australia, where careful experiments have been made in order to ensure that no parasites of the insects are introduced, and that the insects when liberated will not attack cultivated plants or native plants of economic importance. The tests in the latter category were very exhaustive. About fifty insects of each species were placed on plants of 60 different kinds, including cereals, fodder plants, vegetables, fruit trees and timber trees, and in no case were the plants attacked. Up to June, 1924, a series of tests had been completed with five kinds of insects, viz., caterpillars of the moths *Melitara junctolineella* and *Mimorista flavidissimalis*, the cactus-bugs *Chelinidea tabulata* and *C. vitteger*, and the cochineal insect *Dactylopius tomentosus*. The Governments concerned have authorised the liberation of these insects in the prickly pear areas. Tests with several other insects were still in progress at the close of the period.

Three field stations for the rearing of the insects have been established by the Board. Two are in Queensland, at Westwood in the central district and at Chinchilla in the south, and the third is at Biniguy in the Moree district of New South Wales. So far, insects of two species have been liberated from these stations, viz., the cochineal, *Dactylopius tomentosus* and the moth *Melitara junctolineella*. Three strains of the former have been introduced and acclimatised. One, introduced independently of the Board from Chico in California, has been distributed widely by private agency and has proved very

destructive to the common prickly pear, *O. inermis*, particularly when the plant is growing in scrub and sheltered situations. It has spread well also on the spiny pear, *O. stricta*, but is not so destructive to that plant. Another strain from Texas, has proved specially destructive to *O. stricta*, but does little injury to *O. inermis*. The third strain was obtained from Arizona, and appears to be about equal in virulence to the Chico strain on *O. inermis* and to the Texas strain on *O. stricta*.

Caterpillars of the moth *Melitara junctolineella* were liberated in the open on *O. inermis*, at Chinchilla and Biniguy, early in 1924. The total number liberated was over half a million, and they caused a good deal of injury to the plants.

The experiments have not been continued long enough to determine definitely what effect the insects will ultimately have on the pest. There seems every reason to believe, however, that they will be as destructive in the open as they have proved in cages, in which case when they are firmly established and spread throughout the pear areas, they will at least serve to hold the pear in check, and there is every hope that in time they may reduce its quantity very considerably or even destroy the bulk of it.

In certain parts of America fungi seem to be even more effective than insects in controlling the growth of prickly pears. Of the regions investigated, diseases due to fungi were specially prevalent in Florida and Argentina. Very little is known, however, about these diseases and lack of funds has so far prevented a proper investigation of their life histories. It is hoped that the Board will be able to make arrangements in the near future to carry out investigations on this side of the work.

Trinidad Forests.—A number of official papers now available direct attention to the forest resources of Trinidad and Tobago. A *Report on Forestry in Trinidad and Tobago*, by Captain R. C. Marshall, Conservator of Forests (*Council Paper* No. 108 of 1924) outlines a policy aiming at rendering the colony independent of the large imports of foreign timber (softwoods), valued at over £200,000 per annum, from the United States and Canada. The land covered by forest is estimated at 51 per cent. of the total area of the colony, the forest reserves amounting to 338 square miles or 17 per cent of the total land area. The forests are relatively accessible and in the majority of cases suitable for intensive working. The Conservator considers that the existing reserves should be sufficient, under proper management, to supply the timber needs of the colony and to leave a surplus for export. The forests of the colony are tropical rain forests, the principal types being as follows: (*a*) *Mangrove forests*, between high and low water marks, the prevailing species belonging to Rhizophora,

Avicennia and Xylocarpus; (*b*) *cedar forests* containing, associated with the cedar (*Cedrela mexicana*), cypre (*Cordia alliodora*), balata (*Mimusops globosa*), balsam (*Copaifera officinalis*), purpleheart (*Peltogyne porphyrocardia*), etc.; (*c*) *mora forest* characterised by the one naturally gregarious tree of the colony, viz. *Dimorphandra Mora*, accompanied by balata and crappo (*Carapa guianensis*); (*d*) *savannah forest* simulating a northern meadow with clumps of palms (*Mauritia*, *Euterpe*, etc.), crappo and other species; (*e*) *arenaceous forest* containing poui (*Tecoma serratifolia*) as the chief timber tree; (*f*) *hill forest* in which balata and cedar are found well above 2,000 feet.

In the past, attention has been given to the planting of selected species. In 1922 the area of the government plantations amounted to 1,248 acres, the most extensively planted trees being cedar, poui, cypre, balsam, locust (*Hymenaea Courbaril*) and East Indian teak (*Tectona grandis*), the last-mentioned being introduced from Burma in 1913. With the exception of teak these plantations have not been wholly successful, but there appears to be little doubt that with fuller knowledge of the sylvicultural requirements of the trees satisfactory results would be obtained. The Conservator points out the need for research into this and other important questions, including the botanical identification of the numerous forest species and the methods of seasoning best suited to local needs. Hitherto, the lack of sufficient staff has prevented the Forest Department from preparing a working plan for the regulation of the forests, and the present Conservator considers that certain species, e.g. cedar and cypre, have been over-cut in consequence. He therefore proposes the preparation of working plans for all areas accessible to regular working and suggests that the plans should be revised every five years. He also proposes a new system of management of the forests leading to the production of even-aged forests of practically pure crops. The statement of the present position of affairs indicates the necessity for a definite forest policy designed to make the colony at least self-supporting in timber, and the outline of a suitable policy is suggested by the Conservator. Useful forest maps of Trinidad and Tobago accompany the report.

In a despatch from the Secretary of State for the Colonies (*Council Paper* No. 8 of 1926) the attention of the Colonial Government is drawn to memoranda prepared respectively by Prof. R. S. Troup and the Forestry Commission containing comments on the above report and recommendations regarding the remuneration of forest officers in Trinidad. Professor Troup is of opinion that there should be a larger area of forest reserves than at present constituted and suggests from 25 to 30 per

cent. of the total land area. He advises caution in the extension of teak plantations and considers that the proposed working plans should be revised at ten year intervals instead of every five years. He emphasises the importance of the proposals made in regard to seasoning, and comments on the suggested forest policy of the Colony and questions affecting the staff of the Forest Department. The observations of the Forest Commission are concerned chiefly with the questions of research and forest policy.

In his *Administration Report* for 1924 (*Council Paper* No. 27 of 1925) the Conservator of Forests states that progress has been made with the reorganisation necessary to give effect to the recommendations of the Committee appointed to consider his general report, to which reference is made above. Attention appears to have been given mainly to experimental work in connection with planting, and useful trials have been commenced with a view to ascertaining the optimum requirements as regards spacing, light and soil for cedar and poui, and the mixtures with other species in which these trees thrive best. The species selected for mixture with cedar comprise cypre, balata, crappo, mahogany (*Swietenia macrophylla*), angelin (*Andira jamaicensis*), locust, galba (*Calophyllum Calaba*), black fiddlewood (*Vitex divaricata*), and laurier (*Lauraceæ*). Several of the same species are also being tried in association with poui. It was hoped to commence the preparation of working plans during 1925.

Preservation of Mine Timber.—The question of the supply of timber for use in mines is becoming increasingly serious in all countries. Not only is there a shortage of timber, but the price has in many instances increased to an even greater extent than can be accounted for by the scarcity alone. It has become necessary therefore for the mine-owner to make the timber he uses last longer, and to utilise woods that previously could not compete successfully with the better timbers. In both instances it becomes necessary to treat the wood in order to make it more durable. A valuable publication dealing with the various aspects of this question has recently been issued by the United States Bureau of Mines under the title "Mine Timber, Its Selection, Storage, Treatment and Use" (*Bulletin* 235), and in view of the general interest of the matter, a summary of the main features of the *Bulletin* is given below. Experiments were recently made in South Africa on the preservation of mine timber and these also are dealt with in the following note.

The first part of the Bureau of Mines *Bulletin* contains information regarding the depletion of the timber resources of the United States and the consumption of timber in mines,

the weights and strengths of different timbers, the salvaging of timber from worked-out parts of mines, the mechanical and other causes effecting the destruction of mine timber, and the protection of timber in mines against fire. This is followed by a section on methods of prolonging the life of mine timber.

For this last purpose the first consideration is the selection and seasoning of the timber. Where the timber is round or partly round the removal of the bark is an important matter, since bark retards seasoning and also encourages insect attack and decay. Apart from cases where chemical preservatives are used, seasoning is of greater importance in timber to be employed in dry parts of mines than if it is to be placed in very wet situations. In the latter case seasoned timber will absorb moisture and rapidly reach the condition of green timber, but in comparatively dry situations there is a distinct advantage in starting with the wood as dry as possible, as otherwise decay may do a considerable amount of damage before the wood becomes sufficiently dry to stop it. Where preservative treatment is to be applied, preliminary seasoning is of paramount importance.

The storage of timber at the mine, if it is not to be used or chemically treated at once, also demands consideration. In piling, it is necessary to keep the pieces well off the ground, by using foundations of concrete or treated wood, and to pile them in such a way that the air can circulate freely round each piece, either by using cross "stickers" or by piling the pieces themselves cross-wise.

The most important means of prolonging the life of timber is by artificial treatment with preservatives. Whether this is economically desirable in any particular case depends on whether the length of time for which the timber will be required to perform a useful function is greater than the life which it would be expected to have in the untreated state, but in most cases such treatment will be profitable, and will increase the useful life of the timber to several times that which it would have if left untreated.

The most important preservative agents dealt with in the above publication are coal tar creosote, zinc chloride, sodium fluoride, copper sulphate, and mercuric chloride, though it is not considered that the last two will ever be extensively used in the United States.

Coal tar creosote has definite advantages, viz. (1) high toxicity, (2) relative insolubility in water and low volatility, (3) ease of application, (4) easy determination of its depth of penetration, and (5) general availability and relatively low cost. Objection is sometimes raised to it on the score of

inflammability, though it is stated that after a few months creosoted wood is not much more inflammable than untreated wood, and is less inflammable than untreated wood in which decay has commenced.

Zinc chloride is described as the standard water-soluble wood preservative used in the United States. Its principal advantages are its relative cheapness, general availability, uniformity, cleanliness, lack of odour, ease of shipment, and absence of "fire hazard." It suffers from the disadvantage of being soluble in water, as a result of which it is liable to be dissolved out of the wood, but in spite of this, experience has shown that it is a valuable preservative.

Sodium fluoride has certain advantages, but is more expensive than zinc chloride.

There are various methods of treatment with preservatives, ranging from pressure processes involving extensive plant to application with a brush. Pressure processes are the most effective, such as the Burnett process for applying zinc chloride, and the Bethell ("full cell") and "empty cell" processes for creosote.

The most effective non-pressure process is the "hot and cold bath" process. The wood is heated for several hours in an open tank with the preservative, and is then rapidly transferred to a cold bath, or the hot preservative is rapidly replaced by cold, and the wood is allowed to remain several hours longer. During the first stage, air and moisture are expelled from the wood and practically no penetration by the preservative occurs; in the second stage the preservative is drawn into the wood. Instead of having distinct "baths" the source of heat may be withdrawn after the first stage and the wood and preservative allowed to cool together. The result is the same but it takes longer to attain. This method is equally applicable to creosote and to preservatives in aqueous solution.

Less complicated, if less efficient, are the processes of cold steeping in aqueous solutions, and, in the case of creosote and similar oils, hot dipping, brushing and spraying.

Different woods show markedly differing susceptibility to treatment, and may have different "orders of merit" according to whether they are to be treated or used untreated. Thus red oak is ordinarily considerably inferior to white oak as a mine timber, but it is easy to treat, and after treatment it compares favourably with more durable varieties. In most woods the heartwood is much more difficult to treat than the sapwood. Chestnut oak, and red and black oaks are comparatively easy to treat even as regards heartwood, on account of the fact that they have large open pores through which

the preservative can penetrate. A corollary of the greater susceptibility to treatment of sapwood as compared with heartwood is that, other things being equal, it is easier effectively to protect round timber than sawn timber.

The preservation of mine timbers by means of zinc sulphate applied under pressure forms the subject of an article in the *South African Journal of Industries* (1925, **8**, 694). An investigation was carried out by arrangement between the South African Forestry Department and the Ferreira Deep, Ltd. The timber used in the experiments consisted of poles of *Eucalyptus Maideni* cut from a 9-year-old plantation and *Acacia mollissima* (black wattle) from trees about 7 years old. The zinc sulphate employed was a waste product obtained in the reduction process at the gold mines. It was used in solutions of various strengths but averaging 3½ to 4 per cent. of zinc.

The poles were treated in cylinders under pressures from 130 to 150 lb. per square inch, for times varying from 1 to 3 hours, and (except in one case) in the cold, and the degrees of absorption were noted. The results showed that, so far as absorption is concerned, there is little to be gained by prolonging the treatment for more than one hour.

It is noteworthy that the depth of penetration was markedly greater in the eucalyptus than in the black wattle, owing to the fact that the former consists almost entirely of sapwood, whereas the latter has a distinct heartwood which is not penetrated by the preservative.

The cost of treatment, exclusive of the cost of the zinc sulphate and interest on capital, is calculated at 1½*d.* per cubic foot of timber, and it is concluded that the chemical treatment of mine timbers on a large scale warrants serious consideration.

Ceylon Rubber Research Scheme.—The annual general meeting of subscribers to the Scheme (*see* this BULLETIN, 1925, **23**, v) was held at Colombo, Ceylon, on 16th April, 1926. The detailed reports on the work in Ceylon and London, a summary of which is given in the following pages, show that during 1925 the Scheme continued to make steady progress. As in 1924–25, grants of Rs.67,500 and £2,000 were made by the Ceylon Government and the Rubber Growers' Association respectively. The receipts from local subscribers in the Colony again exceeded Rs.24,000, and Ceylonese estate owners are commencing to take a greater interest in the work.

Tours of estates in all the rubber-growing districts were made by the Organising Secretary who reports that conditions continue to improve and diseases to receive more careful attention. *Ustulina zonata* is, however, becoming more prevalent on the older estates and will call for much attention

during the next few years. There does not appear to have been any marked increase in brown bast during 1925, but it is urged that the efforts to control the disease should not be relaxed as it is expected to become more prevalent on resumption of full tapping.

Fewer enquiries were received with regard to defects in manufacture than in any previous year, and it is considered that the problems of "spotting" of crepe and "rust" on sheet have been satisfactorily solved. The introduction of formic acid to replace acetic acid as a coagulant was the only change in the methods of manufacture recorded.

Although very little actual budding work was done during 1925, a number of estates are keeping records of high-yielding trees to prepare for budding operations. Efforts to establish cover plants were made by the majority of estates and considerable interest was shown in all matters connected with manuring.

The chemist in Ceylon completed his series of experiments on the control of "mould" on sheet rubber by changes in the system of smoking, the results of which will be published shortly. Extensive trials with hydrometers made to the pattern developed last year showed that glass hydrometers can be used under estate conditions without undue fear of breakage and that, with care, reliable crop estimates can be obtained. Experiments were also carried out on the use of formic acid as a coagulant and of the use of paranitrophenol for the prevention of mould. A large number of samples of smoked sheet and blanket crepe were prepared for tests at the Imperial Institute to compare the standard of uniformity of Ceylon rubber.

The mycologist was engaged principally on a study of the so-called Phytophthora diseases and their causative agent or agents, and experiments were in progress for testing the effect of various disinfectants on the growth of the causal organism of Bark Rot, and field experiments for testing the effect of different disinfectants when applied to the tapping cut. He made a special study of a leaf fall caused by a species of Oïdium, of which the first serious outbreak in Ceylon occurred during the year 1925. A considerable amount of work was also carried out in determining the best method of filling in holes in trees caused by *Ustulina zonata*.

In view of the regular occurrence of leaf diseases in Ceylon arrangements were made recently for the mycologist to visit estates in Southern India to acquaint himself with the successful work carried out there on the spraying of rubber trees for the prevention of secondary leaf fall and pod disease, and he gave a brief account of the results of his investigation at the Annual

General Meeting of Subscribers. Spraying experiments are shortly to be commenced in Ceylon and demonstrations are to be given by the Scheme in various districts of the Island.

During the year the physiological botanist concentrated on his studies of brown bast in the laboratory and in the field, and on the selection of high-yielding trees. He also had manurial experiments and change-over tapping experiments under his control. The Government of the Colony has made a free grant to the Scheme of 50 acres of Crown land within easy reach of the laboratories as an experiment station, and the proposals for the development of this land with selected and budded trees should be of the greatest importance to the rubber industry of the Island.

The arrangements made during the year for the technical officers to address District Planters' Associations upon their research work resulted in very successful meetings, and it is proposed to continue them.

The principal investigations carried out during the year at the Imperial Institute in connection with the Scheme included (1) a comparison of the properties of wet and dry rubber, with special reference to the effect of different amounts of moisture; (2) a study of the variations in plasticity shown by plantation rubber; (3) an investigation of the ageing properties of different forms of plantation rubber after vulcanisation; (4) the effect on the vulcanised rubber of spraying with Bordeaux mixture; and (5) a comparison of smoked sheet prepared by different methods.

An account of the experiments which have been completed on the ageing properties of different forms of plantation rubber is given on p. 209 of this Bulletin. The results so far obtained show that crepe does not age as well as unsmoked sheet after vulcanisation in a rubber-sulphur mixing and this fact is of importance in connection with the utilisation of rubber for certain manufacturing purposes.

The tests on the variations in the plasticity of raw rubber are a recent development and have been undertaken in view of the statements of manufacturers concerning the difficulties which they cause in factory practice. A considerable amount of preliminary work has already been done, principally in connection with devising a satisfactory method of testing, and a detailed comparison of estate grades of Ceylon rubber is now in progress.

Rubber Resources of the Philippines and Latin America.—Under instructions from the United States Congress the Bureau of Foreign and Domestic Commerce are investigating the possibilities of developing the rubber-plantation industry in the Philippine Islands and Latin America, and are issuing in this

connection a series of publications of which four have so far appeared. The first two were "Marketing of Plantation Rubber" (*Trade Information Bulletin* No. 180) and "The Plantation Rubber Industry in the Middle East" (*Trade Promotion Series* No. 2). The two latest, "Possibilities for Para Rubber Production in the Philippine Islands" (*Trade Promotion Series* No. 17) and "Rubber Production in the Amazon Valley" (*Trade Promotion Series* No. 23), have recently been received at the Imperial Institute and are noted below.

Philippine Islands.—After a brief comparison of the conditions obtaining in the Philippines and the Middle East as regards climate, soil, production costs, labour, sanitation, etc., a general description is given of the areas studied, and this is followed by a detailed description of the existing rubber production in the Islands, a survey of potential rubber lands, an account of the different types of soil, a discussion of the labour problem, and particulars regarding costs, methods and transport. It is considered that the climatic conditions of the Philippines are as favourable for rubber planting as those of the Middle East. As regards soil, topography, and accessibility, it is stated that there are large areas that, if utilised for rubber production, would be superior to the lands now generally available for new plantations in Sumatra and Malaya. With a population of over 10,000,000 in the Philippines, it is believed that by bringing natives from the more congested Provinces, to supplement the labour already available in the districts, it might be possible ultimately to furnish a sufficient force to produce 70,000 tons of rubber yearly when the trees are mature. The present land laws do not lend themselves to large capital operations in rubber plantations, but moderate-sized plantations are possible with foreign capital, and the small native planter, with proper encouragement, might become a producer of important further supplies.

Amazon Valley.—The report on this district is divided into two parts, the first forming a résumé and comparison of the data contained in the regional reports that form the second part. For the purpose of the detailed reports the Amazon Basin is divided into nine sections which may be enumerated here to indicate the wide area covered; they are: (1) Islands and Para, (2) Lower Amazon, South, (3) Lower Amazon, North, (4) Upper Amazon, North, (5) Madeira, (6) Upper Amazon, South, (7) Acre, (8) Bolivia, (9) Peru, Ecuador and Colombia. This area includes all those regions where rubber is native or where natural conditions would permit of its cultivation, the total extent being approximately 2,250,000 square miles. For each region an account is given of the physical features, climate, population, labour, health and sanitation, and transport, as well as particulars of the present

distribution of wild rubber and the methods of preparation. In most cases also an interesting general description of the natural vegetation is given, with particular reference to the chief timber trees, oil seeds and other products.

The proper combination of soil and climatic conditions for successful rubber planting exists in many localities and over large and contiguous areas in the Amazon Valley. The most suitable areas are those within reach of the large rivers capable of taking ocean-going vessels, such as the Amazon itself as far as Iquitos in Peru, and the Tapajoz, Madeira and Purus for considerable distances from their junctions with the main river. While excellent natural conditions exist in other regions, the lack of adequate transportation diminishes their chances for the successful establishment of rubber plantations. Development in the more remote regions in eastern Peru, south-eastern Colombia and eastern Ecuador, where physical conditions are favourable, may be dependent on the opening of railway communication between these districts and the Pacific Ocean. As regards the labour supply it is believed that under present conditions a total of 30,000 labourers might be procurable within the Amazon Valley for rubber plantation projects, a force which is considered sufficient to plant and maintain an area of at least 150,000 acres. As a rule, the Amazon labourer is of good physique, inured to exposure, and under proper incentive is capable of long-continued effort. On the average he is possibly superior to the Indian and Javanese labourer employed on the plantations of the middle East and at least equal in efficiency to the Chinese. Public land is available in most regions at a nominal price and there is a possibility that the present high export taxes on wild rubber in Brazil may be reduced as an inducement to the establishment of rubber plantations.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY.

In this section a summary is given of the contents of the more important, recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

FOODSTUFFS AND FODDERS.

Tea. *Quarterly Journ. of the Scientific Dept., Indian Tea Assoc.* (1925, Part IV, p. 127), records the results of experiments to determine the effect on the tea crop of a leguminous crop grown concurrently. The experiments were conducted on a

block of tea divided into 64 plots each containing 80 bushes. Lime was applied in 1922, and up to the end of 1924 its effect on the tea was a very small reduction in the crop. Rahar (*Cajanus indicus*) was grown in 1925 and trenched in at the end of the year. The lime exercised a very good effect on the rahar crop. The crops of tea plucked during 1924 and 1925 were recorded and thus furnished a comparison between tea growing in clean soil and tea growing among green crops. The results established that when grown among green crops the tea crop suffers a loss of roughly 13 per cent. for every 100 maunds of green crop per acre. The subsequent advantage of the green manuring is well known, and it is recommended to reduce the losses during the growth of the leguminous crop by sowing late and trenching early, by thinning out the leguminous plants to 1 foot apart, and by manuring.

A pamphlet of 34 pages by J. W. H. Bradshaw, entitled "Tea Cultivation in Kenya Colony," has been published by the *East African Standard*, Nairobi (1925). The production, manufacture and marketing of tea in Kenya is fully but concisely described, and the costs of planting, manufacture, equipment, and maintenance of the estate and factory are recorded.

Coffee.—The fungoid diseases of coffee in Kenya Colony and their remedial treatment are described in *Bull.* No. 3, *Dept. Agric., Kenya*. The leaf diseases dealt with are rust or leaf disease, brown blight, brown eye spot, and black blight or sooty mould, while two diseases of the berry are described, viz., brown blight and coffee berry or black berry disease. Those attacking the stem are pink disease and anthracnose. With regard to root diseases, these have so far not caused any widespread loss in Kenya, and although the presence of a fungus has been discovered in the tissue of diseased roots it has rarely been possible to state which particular fungus is concerned. The seedling disease, occurring in the nurseries, and the physiological diseases, dieback and black tip, are described, as well as chlorosis.

Sugar Beet.—Investigations regarding the time of year to plant mother beets for seed production are recorded in *Journ. Agric. Research* (1925, **30,** 811). It was found at the Salt Lake City Station (Utah) that beets planted early, viz., in March, produced abundant seed, while those planted later produced little or no seed. The second year's development of the mother beet is composed of two distinct periods. The first period is one of food mobilisation, vegetative foliage development, new root production, and absorption of soil

nutrients. The second period is characterised by rapid utilisation of mobilised food, development of seed stalks, and production of seed. The amount of seed produced is directly proportional to the extent of development during the first period.

The Ministry of Agriculture have accepted from Sir Charles Cottier the British and Irish rights in the De Vecchis process for the production of sugar from beet (see this BULLETIN, 1925, **23**, 352). These rights have been assigned to the Ministry free of charge, on certain conditions, particularly with regard to further experiments. The Ministry will grant non-exclusive licences to use the process (*Journ. Min. Agric.*, 1926, **32**, 981).

The Ministry of Agriculture have published a *Research Monograph*, No. 3 (1925), price 3*s.*, entitled "Sugar Beet. The Results of an Enquiry into the Costs of Production, Yields and Returns in 1924." It deals with an investigation carried out by the Agricultural Economics Research Institute of the University of Oxford into the costs and returns of sugar beet growing on certain farms in 1924. The production of roots, the value of by-products, the effect on farm routine and farm systems, and the general considerations from a farmer's point of view are fully discussed.

Wheat.—*Bull.* No. 1347 (1925), *United States Dept. Agric.*, deals with " Foot-Rot Diseases of Wheat in America." These diseases are rather widespread in the United States and cause losses of economic importance in several of the principal wheat districts. Although the studies which have been carried on by numerous investigators have thrown considerable light on these diseases, they have done little more than to assist in defining some of the problems, and to indicate that soil fungi are in many cases the limiting factors in wheat production. In this Bulletin the more important information regarding foot-rot diseases of wheat as they occur in America is set out and discussed.

Barley.—All the available data and information regarding the varieties which have been grown in field experiments in the United States and Canada have been collected and published in *Bull.* No. 1334 (1925), *United States Dept. Agric.* In the 218 pages of the Bulletin the subject is treated comprehensively, and numerous details of yields per acre are included, together with an index to varieties and to experiment stations.

Bananas.—The *Ann. Rep. Dept. Sci. and Agric., Jamaica*, for the year 1924 states that the banana industry suffered from unfavourable seasons and bad markets. The crop was

slightly under 12 million stems, or 483,000 stems less than in the previous year. The Panama disease increased during the year, and certain areas in Portland where the Gros Michel banana has been grown continuously for the past 40 years are now clearly doomed and some other variety, resistant to the disease, will have to be planted on these lands. At present there are two varieties in Jamaica known to be resistant, viz. the " China " and the " Robusta." Both of these varieties have disadvantages commercially. The former, which is the variety grown in the Canary Islands, only grows well on good land and the fruits require careful packing to avoid injury in transit. " Robusta," recently introduced from Central America, ripens so as to be practically identical in texture and flavour with the ordinary banana of commerce, and is accepted as ordinary fruit at buying stations. It is, however, less strongly furnished as to stem, and the skin is more liable to bruising than the ordinary commercial varieties.

Sunflower Silage.—In view of the interest attaching to the substitution of sunflowers for maize as a silage crop in areas where the latter does not grow satisfactorily on account of climatic factors or the attack of insect pests, the methods of culture and harvesting of the crop have been investigated in Illinois, and the results are recorded in *Bull.* No. 268 (1925), *Univ. of Illinois Agric. Exper. Sta.*, entitled " The Sunflower as a Silage Crop." The yield and composition of a sunflower crop grown in 1921 were obtained from samples collected in the field at eight stages of growth and from the crop as ensiled at three stages of growth. The feeding value of the silage and digestibility factors were determined for the three stages and are recorded in *Bull.* No. 253 of the same station. It was found that sunflowers require to be ensiled at a much earlier stage of growth than maize, and they produced 50 per cent. more dry matter per acre than two fields of silage maize grown near-by. The amounts of ash, crude fibre and fat were very much greater in the sunflower crop than in the maize crop, but the latter gave a greater amount of nitrogen-free extract.

Subterranean Clover.—This clover, *Trifolium subterraneum*, is described in *Journ. Dept. Agric. Victoria* (1925, **23**, 705). During the last twelve years it has been extensively planted on all classes of soil in dairying, cattle and sheep country of Victoria. It constitutes a most valuable fodder plant, and has proved an important means of effecting an improvement in the carrying capacity of pastures. Although an annual, it re-establishes itself very readily from seed, and is in effect a perennial when once introduced. On first-class land it tends to crowd out plants of higher fodder value and a longer period

of growth, such as white Dutch clover and Alsike clover, and though it makes vigorous growth in the spring, it dies off completely in the summer, leaving bare pastures. It requires a rainfall of not less than 20 in., and its proper sphere is in areas where better-class clovers are not permanent. It has given remarkable returns on the light soils of the Western District and elsewhere.

OILS AND OIL SEEDS.

Coconuts.—Of the copra exported from Fiji, about one-quarter is plantation grade, five-eighths South Sea grade and the remainder of an inferior grade. The copra industry is exploited chiefly by men of small capital and by natives. One-third of the copra is produced on native plantations, the total area of which exceeds that owned by Europeans. The wastage is high and the quality low. It is strongly recommended that the industry should be run on co-operative lines, the nuts being supplied to central factories where they would be converted into copra. By this means the quality of the product would be improved and the growers would receive greater remuneration. Work has been started in connection with the control of the moth, *Levuana iridescens*, and information has been collected on the habits, prevalence, etc., of this pest and of allied species. It is hoped to introduce parasites from Java, chiefly tachinid parasites on *Brachartona*, as a means of controlling the ravages caused by this moth (*Ann. Rep., Dept. Agric., Fiji*, 1924, p. 1).

The diseases of coconut palms investigated by the mycologist, Fiji, during 1924 included thread blight (*loc. cit.* p. 13). This is a leaf disease and is characterised by the presence of a spreading whitish mycelium growing usually on the under surface of the leaf, on the midrib and adjacent parts of the leaflets. The mycelium is massed together in thread-like bundles and eats away the substance of the leaf with the result that the affected leaves die. This blight is probably due to a species of *Corticium*. The conditions under which coconut palms are grown make control methods rather futile. Any control method adopted would, however, be based on the collection and destruction of the diseased leaves and spraying with Bordeaux mixture or a lime-sulphur wash.

Since 1898 the exports of copra from the Philippine Islands have increased from 15,111 tons to 203,858 tons in 1923, and the exports of coconut oil from *nil* in 1898 to 87,774 tons in 1923 (*U.S.A., Dept. Comm., Bur. For. Dom. Comm., Trade Promotion Series* No. 11, 1925). Up to 1913 France took over one-half of the copra exported, but since 1922 the greater portion has gone to the United States. This diversion has been caused

partly by the effects of the war; partly by the augmented demand in the United States for coconut oil and partly by a growing predominance of American ships in the carrying trade of the Philippine Islands. The production of copra in 1923 was 362,563 tons. Three methods of drying copra are in use, and the quality and grade of the product depend on the method employed. Sun-drying, which requires five days, yields copra of first quality, containing 9 per cent. of moisture. The weather conditions, however, are not suitable for this method of drying in most parts of the Islands. Drying in tapajans is therefore used. In this case the copra is dried by smoke and from five to twelve hours are required to complete the process (see this BULLETIN, 1925, **23**, 65). Artificial drying is at present practised only in a few isolated cases, but additional factories are in course of construction. Tapajan-dried copra forms the bulk of the copra prepared. This variety is classed in four grades, depending on the percentage of moisture. The lowest grade, known as "Manila corriente" or "current quality," contains 18 per cent. of moisture. Then follow "Manila buen corriente" or "good quality" with 12 per cent., "semi-resacada" or "partly resacked" with 8 per cent., and the best grade, "resacada" or "resacked," with 6 per cent. "Corriente" and "buen corriente" are the most common grades. The only sun-dried copra exported in any quantity is "Cebu sun-dried."

The coconut oil industry in the Philippine Islands is a very important one, these Islands exporting in 1922 as much as 74 per cent. of the total exports of coconut oil from the principal producing countries. The first modern mill for the manufacture of this product was erected in 1906 in Manila, but three years later was unfortunately burned down. A new mill was erected in 1913 and by the end of 1918, 41 mills were operating. The fall in the price of the oil, caused by a decreased demand from the United States, when the war ended, was quickly followed by a boom in the trade. Early in 1920 this strong demand ceased. On account of the financial difficulties caused by the slump, the mills were re-organised and in many cases consolidated, three of the largest mills forming a combine which is controlled by British interests. The mills have been re-equipped and can now produce coconut oil as efficiently as is done in America and Europe. The copra is given a first pressing in expellers whereby the oil-content is reduced from 64 to 22 per cent., and is then pressed in hydraulic presses to give a cake containing only 5 or 6 per cent. of oil. During the boom in the oil, solvent extraction was tried but was found to be unsuitable owing to the high price of the solvent, the lack of skilled labour, and the high loss of solvent by evaporation due to the climate. The bulk of the coconut oil

produced in the Philippine Islands goes to the United States. Of the 50,016 tons of coconut cake exported in 1923, 31,927 tons went to the United States and 12,572 tons to Germany.

Oil-palm.—The only oil-palm plantations in Sierra Leone are at the Experimental Farm, Njala. With a view to the education of the natives and to show the advantages of modern methods of managing oil-palm estates, demonstration plots of cultivated wild palm stands have been inaugurated in some districts (*Ann. Rep. Lands and For. Dept., Sierra Leone*, 1924, p. 14). Preliminary trials have been made with Culley's depericarper and nut-cracking machine, but, up to the present, the former machine has not proved a complete success, probably owing to the inability to soften the pericarp sufficiently. Further trials with the depericarper are, however, being undertaken. The nut-cracker has given fairly satisfactory results.

An investigation of the different varieties of oil-palm found in Sierra Leone has been started. So far, five distinct varieties have been recognised and botanical specimens forwarded to the Royal Botanic Gardens, Kew, for identification. The fruits of these five varieties have been examined. Kawei, the common type, with a thick shell, yielded 20 per cent. of pericarp, containing 47·5 per cent. of oil; Kpolei and Henoi, both with thin shells, yielded respectively 58 per cent. of pericarp containing 38·5 per cent. of oil, and 47 per cent. of pericarp containing 50·1 per cent. of oil. Tugboi has a shell of a soft fibrous nature with little or no kernel. It yields 74 per cent. of pericarp, containing 36·5 per cent. of oil. Jackeye, another thick-shelled variety, has 22 per cent. of pericarp containing 39·7 per cent. of oil. This last-named palm oil is always distinguished by the natives from other kinds of palm oils and is never mixed with them. On examination it was found to darken considerably in colour on heating to 100° C. Of the five varieties, Tugboi gives the highest yield of palm oil from the whole fruits.

ESSENTIAL OILS.

Palmarosa Oil.—According to *Bull. Dept. de l'Agric. et de la Pêche, Seychelles*, No. 6, Feb., 1926, plants and seeds of palmarosa recently introduced into Seychelles have given encouraging results. The variety of *Cymbopogon Martini*, Stapf, known as "Motia," produced much better results than the variety "Sofia," from which in India ginger-grass oil is derived, and the plants flourished best in localities where the ground was humid and fertile. A sample of the palmarosa oil from an

experimental distillation examined in London contained 93 per cent. of total geraniol, and thus compared very well with Indian palmarosa oil which, according to Parry, contains from 78 to 92 per cent. of total geraniol.

Camphor.—*Laurus Camphora* is stated to have existed in Algeria before the French occupation, and isolated specimens of the tree grown for ornamental purposes are still found in various localities (*La Parfumerie Moderne*, 1926, **19**, 4). The leaves from some of these trees have furnished from 1·0 to 1·7 per cent. of camphor. Experiments which have recently been conducted have shown that Algeria is well adapted to the cultivation of camphor, and it is considered that the trees would yield sufficient camphor to render production remunerative. The best results were obtained where the soil was light and alluvial. The trees appeared able to withstand snow and even frost, but succeeded best at altitudes below 300 metres with a north aspect.

Peppermint Oil.—An instructive brochure on the cultivation of Franco-Mitcham peppermint, by J. Ripert, has been published as *Notice No.* 22 (1926), of the *Office nat. des Matières prem. veg. pour la Drog. et la Parfumerie, Paris.* In a preface, M. Em. Perrot explains the present position and points out that for twenty years attempts have been made in France to produce oil of the quality of that of Mitcham peppermint, but without success. The conditions of soil and climate have been considered unsuitable, or the stock is supposed to degenerate. The subject is now being studied afresh by l'Office national des Matières premières, and a number of roots have been brought over from England, some by aeroplane, and carefully multiplied in Paris. By March, 1926, nearly 800,000 roots had been distributed to various stations in France, differing widely in latitude, altitude and composition of soil. It is thus hoped to discover a means of cultivating this valuable variety of peppermint in France on a large scale. The present publication has been written to encourage its general cultivation in that country. The author considers this to be a matter of national economic importance in view of the small amount of peppermint now produced in France in comparison with the quantity consumed. In 1923, 45 tons of dried peppermint were imported into France in addition to considerable and unknown quantities of the peppermint essences. The author deals in a very comprehensive way with all aspects of the cultivation, and shows that the peppermint plant is easily grown with little expenditure, and furnishes good returns in any part of France and on all soils suitable

for ordinary crops. Recent returns from various districts in France show that the dried herb has yielded from 0·95 to 5·5 per cent. of oil containing from 41·5 to 56·7 per cent. of total menthol.

Eucalyptus Oil.—A revised edition of the pamphlet on the "Extraction of Eucalyptus Oil in the Field" by A. R. Penfold has been issued as *Bull.* No. 4 (1925) of the *Tech. Educ. Branch, Technological Museum, Sydney.* In order to collect and distil eucalyptus leaves in New South Wales, it is necessary to obtain a special license from the Forestry Commission, particulars of which are given in this publication. The number of eucalyptus species which have been examined for oil is about 177, but only about 14 are at present of economic value; plates illustrating the leaves, buds and fruits of the more important of these species are given to assist prospective distillers. The author states, however, that as both the yield and quality of the oil from a particular species are liable to considerable variation when obtained from different districts, it is advisable in addition to definite identification of the species, to have a trial distillation carried out on leaves and terminal branches of trees selected over a wide area. For those distilling in a small way there is no still more convenient and portable than that constructed from the usual 400 gallon ship's tank, costing at the present time £5 to £12 each; it is said that about 90 per cent. of the working stills in New South Wales consist of a pair of these tanks coupled together. The cost of erection of a pair of tanks is usually about £25 though it might cost up to about £40 or £50 in somewhat inaccessible places.

The average lengths of time required for the distillation of some of the principal species are recorded. Descriptions are given of methods of concentration and rectification for increasing the amount of cineole in oils used for medicinal purposes, and of piperitone in oil of *E. dives;* the latter substance is in considerable demand for the manufacture of synthetic thymol and menthol. The species *E. citriodora* which yields an oil consisting almost entirely of citronellal, and *E. Macarthuri* furnishing an oil rich in geranyl acetate and geraniol are not found to any large extent in New South Wales.

FIBRES.

Cotton.

Cotton Seed Disinfection.—Cotton seed is liable to carry fungal spores and bacteria on the seed-coat and these are protected from the action of ordinary disinfectants by the covering of lint and fuzz. In 1911 it was suggested by Duggar of the Alabama Agricultural Experiment Station that sulphuric

acid might be used as a means of removing the fuzz from the seed and effecting the destruction of the spores and bacteria. Owing, however, to the lack of a machine for mixing the acid with the seed, the treatment was slow, expensive and dangerous, and has therefore not been generally adopted.

A machine has now been described by J. G. Brown and Frederick Gibson (*Bull. No.* 105, *University of Arizona Agricultural Experiment Station*, 1925) which removes the fuzz quickly, thoroughly and safely. The sulphuric acid treatment thus applied ensures the surface sterilisation of the seed, the hastening of germination, increased percentage of germination, ease in handling the seed for sowing, and a healthier and more uniform stand. The cost of the treatment is discussed, and suggestions are made for operating the machine.

Papua.—A short article on the pink boll-worm by E. Ballard, B.A., F.E.S., the Australian Commonwealth Cotton Entomologist, has been issued in a pamphlet published by the Home and Territories Department for circulation in Papua and Mandated Territories under Commonwealth control, and has been reprinted in *Queensland Agric. Journ.* (1926, **25,** 23). The pest occurs in the "dry belt" of Papua (50 miles east and west of Port Moresby) and in Rabaul and its vicinity, and has probably been introduced into this area since 1912. It is not known whether the pink boll-worm is indigenous to the Western Districts of Papua or, if not, when it was introduced.

The article gives a brief account of the insect and indicates the necessary precautions and control measures to be taken to prevent its multiplication and depredations.

Queensland.—During recent efforts to develop the cotton-growing industry of Queensland, a number of different varieties were introduced, with the result that they became mixed and hybridised and a very uneven crop was produced. With a view to the ultimate displacement of this mixed cotton by a uniform type, the Australian Cotton Growing Association in 1921 imported a large supply of Durango cotton seed. An account of the results obtained with this seed and of tests carried out with other varieties has been given by W. C. Wells, Cotton Specialist, in a "Report on the Cotton Breeding Operations in Queensland" which has been published in the *Queensland Agric. Journ.* (1926, **25,** 31). It has been found that the Durango cotton gives as good or even better yields than the ordinary mixed cotton, and that the lint is of superior texture and staple and therefore of greater value. The Department of Agriculture have therefore distributed large quantities of the

seed. It is not maintained that Durango is the most suitable type for Queensland conditions, but at present it is the only variety of which any large amount of pure seed is available. Selection work is being carried out with this cotton and also with the varieties known as Acala, Lone Star, Webber 49, Delta-type Webber and Lightning Express, and the results hitherto obtained are recorded. The Department of Agriculture hope that the production of cotton in the State may eventually be restricted to one variety, special strains of which would be developed for each general area. In this way a uniform cotton would be produced throughout the Queensland cotton-growing areas to the great advantage of the industry as a whole.

Further information on cotton experiments in Queensland will be found in a detailed report by G. Evans, M.A., C.I.E., which has appeared in the *Queensland Agric. Journ.* (1926, **25**, 133). This report deals with the work carried out during the 1924–25 season on the following Queensland State Farms :—(1) the Callide Cotton Research Station at Biloela in the Callide Settlement ; (2) the Monal Creek Cotton Experimental Farm in the Upper Burnett ; and (3) the Gatton Agricultural College and High School. Owing to the newness of these stations and the unfavourable weather experienced during the season, many of the experiments gave inconclusive results, but it has been considered that the publication of the reports may be of value to cotton growers in Queensland as a guide in their operations and as suggesting means of overcoming difficulties which may be encountered.

Calotropis procera.

The fibrous products obtainable from *Calotropis procera* and their investigation at the Imperial Institute have been referred to in several issues of this BULLETIN (1905, **3**, 221 ; 1911, **9**, 70 ; 1913, **11**, 204 ; 1919, **17**, 14).

An interesting review of the various attempts which have been made to utilise these fibres and of investigations which have been carried out has been given by Antonio Ferrara in *L'Agricoltura Coloniale* (1926, **20**, 81). Information is supplied regarding the botanical characters, geographical distribution and uses of the plant, and a detailed account is given of the characters, properties, preparation and uses both of the seed-hairs (floss or silk-cotton) and the bast fibre of the stem. From a study of the particulars available, the following conclusions are drawn.

The seed-hairs of *Calotropis procera* can be used as a substitute for true kapok as a stuffing material for cushions, etc.

The stem fibre is difficult to obtain in the form of long, fine strands but is easily resolved into its ultimate fibres which are suitable for spinning and weaving, either alone or better in admixture with cotton. It is not possible to express a definite opinion regarding the character and quality of the textile materials obtainable until the results of technical and economic experience have become available. Assuming that satisfactory solutions are found to the problems of extracting the fibre from the stem and spinning and weaving it, either alone or mixed with cotton, it is evident that if the fibre is to become the basis of an established textile industry it must be placed on the market in sufficiently large quantities and of as regular and uniform a character as possible. This could not be effected by the use of the wild plants alone (at least in the Italian Colonies) and it would therefore be necessary to obtain the fibre by cultivation. The question of the adaptability of the plant to cultivation opens up a series of problems requiring investigation, and judgment on the economic possibilities must therefore be suspended until a systematic series of experiments has been carried out.

A bibliography of the subject is appended.

Paper-making Materials.

Doum Palm (*Hyphaene thebaica*, Mart.).—An account of a detailed investigation of the wood and leaves of this palm, with particular reference to their suitability for paper-making, has been given by Prof. F. Heim de Balsac, in collaboration with M. Cercelet, J. Maheu, G. S. Dagand and R. Heim de Balsac, in *Bull. de l'Agence Gén. des Col.* (1925, **18**, 1038). The anatomical structure of the stem and leaf are fully described with the aid of excellent diagrams, and the results of a microchemical study are given.

Paper-making trials were made with the wood and with the leaf (including both petiole and lamina) of palms from the Goundam and Issa-ber districts of the French Soudan.

The wood contained 11·09 per cent. of moisture; on chemical examination it yielded 1·21 per cent. of ash, 1·05 per cent. of fats and waxes, 48·80 per cent. of cellulose, and 48·94 per cent. of lignone (calculated on the dry material). The lamina contained 10·75 per cent. of moisture; it yielded 17·63 per cent. of ash, 0·76 per cent. of fats and waxes, 27·70 per cent. of cellulose, and 53·91 per cent. of lignone (calculated on the dry material).

On digestion with caustic soda under pressure, the wood furnished a dark brown pulp and the leaves (petiole and lamina) a pulp of a lighter tint; both pulps bleached fairly easily but that from the wood somewhat less easily than that

from the leaves. The yield of bleached pulp from the wood amounted to 35 per cent. and that from the leaves to 27 per cent. (expressed in each case on the dry material).

On microscopical examination, the pulp in each case was found to be composed of cylindrical, regularly tapering fibres, with a lumen of variable size. The fibres of the pulp from the wood vary in length from 0·8 to 1·5 mm., with an average of 1 mm., and have a diameter of 25–45 μ, with an average of 30 μ; those of the leaf pulp range from 0·8 to 2 mm. in length, with an average of 1·5 mm., and in diameter from 10 to 25 μ, with an average of 15 μ. The felting powers (diameter : length) are 0·03 and 0·012 respectively.

The paper made from the pulp obtained from the wood was of inferior quality, whilst that from the leaves was of good quality. The yield in the latter case, however, was rather low.

"Matsia" Grass (*Sporobolus pyramidalis*, Beauv.).—The authors of the study of the doum palm, referred to above, have also published an account of an investigation of the "Matsia" grass of Madagascar (*Bull. de l' Agence Gén. des Col.* (1925, **18**, 1244). This grass grows abundantly in the western parts of the island where it often covers hundreds of hectares to the exclusion of all other vegetation. It occurs on lands which are submerged during the rainy season and can be cut regularly every year after the water has subsided, the yield amounting to 10–15 tons of dry material per hectare.

A detailed and well illustrated description of the anatomical structure of the stem of the grass is given together with the results of a micro-chemical study.

The stems contained 9·52 per cent. of moisture; on chemical analysis they yielded 6·43 per cent. of ash, 1 per cent. of fats and waxes, 45·31 per cent. of cellulose, and 47·26 per cent. of lignone (calculated on the dry material). On digestion with caustic soda under pressure, the stems furnished a pale grey pulp which could be easily bleached. The yield of bleached pulp amounted to 29 per cent. (expressed on the dry material). On microscopical examination, the pulp was found to consist of fibres and a fairly large proportion of cellular tissue and fragments of vessels; the fibres were fine, of cylindrical form, and had the following dimensions: Length, from 0·5 to 4 mm., with an average of 2 mm.; diameter, from 5μ to 12μ, but mostly about 5–6μ. The felting power (diameter: length) was 0·003. The pulp furnished a paper of good appearance, and of excellent strength and durability.

These results indicate that the grass is capable of giving a pulp of good quality, but in rather low yield. It is suggested that a half-stuff could be prepared on the spot and thus reduce the cost of transport to a minimum.

Madagascar Palms.—The same workers have also studied two Madagascar palms, known as "Satrabe" (*Medemia nobilis*, Hild. and W. Drude) and "Satramira" (*Hyphaene Schatan*, Boj.) and have published the results in *Bull. de l'Agence Gén. des Col.* (1926, **19**, 23). In each case, separate investigations were made of the stem, petiole and lamina.

Satrabe.—The following results were obtained on chemical analysis :—

	Stem *per cent.*	Petiole *per cent.*	Lamina *per cent.*
Moisture	7·84	9·36	9·05
Ash (calculated on the dry material)* . . .	5·30	6·84	7·00
Fats and waxes (do.) . .	1·00	0·70	0·64
Cellulose (do.) . . .	79·15	75·40	66·20
Lignone (do.) . . .	14·55	17·06	26·16

On digestion with caustic soda solution under pressure, the stem furnished a brown pulp and the petiole and lamina yellowish-grey pulps; the pulps bleached easily and the yields of bleached pulp amounted to 31 per cent. from the stem, 26 per cent. from the petiole and 22 per cent. from the lamina (expressed in each case on the dry material).

On microscopical examination, the pulp in each case was found to consist of fibres with a small proportion of vessels and parenchyma. The stem fibres were spindle-shaped, longitudinally striated, and generally had a wide lumen; those of the petiole were regular, tapering into flexible points, with a lumen of average width; the fibres of the lamina were cylindrical, pointed and had a weak lumen. The fibres had the following dimensions :—

		Stem	Petiole	Lamina
Length	Range mm. . . .	0·8–1·4	0·8–2·5	0·5–2·3
	Average mm. . . .	1·0	1·7	1·5
Diameter	Range μ . . .	25–50	10–20	10–20
	Average μ . . .	40	15	15
Felting Power (diameter/length) . .		0·04	0·009	0·010

The pulp from the stem furnished a paper of inferior quality and could only be employed as a filler. The two parts of the leaf, on the other hand, gave papers of good quality and, in spite of the low yield, would be of definite interest for paper-making.

Satramira.—This palm gave the following results on chemical analysis.

	Stem *per cent*	Petiole *per cent.*	Lamina *per cent.*
Moisture	8·19	10·23	9·42
Ash (calculated on the dry material) . . .	5·83	6·22	6·43
Fats and Waxes (do.) . .	1·10	0·96	0·72
Cellulose (do.) . . .	68·32	70·08	60·00
Lignone (do.) . . .	24·75	22·74	32·85

On digestion with caustic soda solution under pressure, the stem furnished a greyish-pink pulp; the petiole, a bright brown pulp; and the lamina, a chestnut brown pulp; the pulps bleached easily and the yields of bleached pulp were 29 per cent. from the stem, 28 per cent. from the petiole, and 22 per cent. from the lamina (expressed in each case on the dry material).

On microscopical examination, the pulps were found to consist of fibres, together with fairly numerous accessory elements in those from the stem and petiole, and but few in that from the lamina. The fibres in all cases were cylindrical and pointed; the lumen was wide in the stem fibres and narrow in the fibres of the petiole and lamina. The fibres had the following dimensions:—

			Stem	Petiole	Lamina
Length	Range	mm.	1·0–2·25	0·5–2·0	1·0–3·5
	Average	mm.	1·7	1·4	2·0
Diameter	Range	μ	20–35	10–20	10–20
	Average	μ	30	15	15
Felting Power (diameter/length)			0·018	0·011	0·008

Each of the three parts of the palm gave a pulp which furnished paper of an average quality. The yield is rather low, especially in the case of the lamina, but the whole plant would be of interest as a raw material for paper-making.

Terap, Tutor and Baru Barks.—The barks of the Terap (*Artocarpus Kunstleri*, King), Tutor (*Hibiscus macrophyllus*, Roxb.) and Baru (*Hibiscus floccosus*, Mast.) are used by the natives of the Malay Peninsula as sources of serviceable fibrous material, and were at one time largely used in the construction of the walls of their dwellings. The Terap bark is still employed for making cordage and netting for fishing, and when beaten out is sometimes used as a cloth. An account of a chemical examination of the fibre from these barks has been given by R. O. Bishop in the *Malayan Agric. Journ.* (1925, **13**, No. 12, 376).

It has been found that the Tutor and Baru fibres are composed of ultimate fibres of an average length of about 3·3 mm.; they are very similar in both chemical and microscopical characters and appear to be suitable for making a paper of good quality.

The Terap bark fibre is similar to the Tutor and Baru fibres in chemical composition and behaviour but has much longer ultimate fibres (average length, 18 mm.). In this respect the fibre is comparable with hemp and might perhaps be used for the same purposes.

Water-Hyacinth.—The water-hyacinth (*Eichhornia crassipes*) is a troublesome weed in many tropical countries and sometimes occurs in such abundance as to block the water-ways

and impede navigation. An investigation has recently been made by L. Vidal and M. Aribert with a view to determine whether the plant would be of value as a raw material for the manufacture of paper, and their results are recorded in *L'Agronomie Coloniale* (1925, **13**, 252).

The work was carried out with a consignment of leaves from Indo-China where the plant is known as "Luc-Binh." It contained 5 per cent. of moisture, and 32 per cent. of cellulose (calculated on the dry material) and furnished 5 per cent. of ash.

The pulp obtained by digestion with caustic soda solution is composed of fibres 2–3 mm. long and 12–30μ in diameter; the fibres appear under the microscope as flat, transparent ribbons with thin walls.

Pulping trials were carried out with lime and also with caustic soda, but the results were by no means encouraging. By means of the lime process a yield of 35 per cent. of pulp was obtained which could not be bleached. On digestion with caustic soda the leaves furnished 27 per cent. of pulp which could only be bleached with difficulty; moreover, the paper obtained from the pulp is lacking in strength and of somewhat inferior quality.

The results show that it is possible by means of the lime process to obtain a brown wrapping paper of fair quality, but the yield is only about one-half of that given by straw. The material could be used in conjunction with straw, but it is considered that it would be unwise to establish a factory specially for this purpose. It is practically impossible to obtain a white paper from the soda-pulp and the treatment of the plant by the soda process would not be remunerative owing to the small yield obtainable and the poor quality of the product. The article is illustrated with specimens of paper prepared from pulp obtained by both processes.

RUBBER.

Longevity of Hevea Trees.—The opinion was expressed recently in the *Straits Times* that a considerable proportion of the rubber trees in Malaya are now past their prime, which was regarded as from 12 to 15 years. F. G. Spring in *The Planter* (*Malaya*) (1926, **6**, 236) points out that the experience of the Department of Agriculture does not bear this out, and is, in fact, directly contrary on estates where the rubber is grown under good environmental conditions. He states that observations on the longevity of *Hevea brasiliensis* are being recorded and yields are being noted of trees in the neighbourhood of 30 years of age. The results, up to date, indicate that when decreasing yields per acre are found, the true cause lies, not in the age of the trees, but in bad environmental conditions,

brought about by a number of causes such as soil erosion, severity and quality of tapping, bad soil moisture conditions, impoverished soils, and disease. It is known that under wild conditions in Brazil, trees of great size and age continue to give large yields, but various factors may have an influence on the longevity of the tree when grown under plantation conditions in the East. Undoubtedly disease is one of the chief factors to be reckoned with, and on areas which have to be continually thinned out on this account there may come a time when the number of trees to the acre is so small that replanting is necessary. The question of bark renewal in old trees is also one of importance. To sum up, Mr. Spring considers that the plantation industry is not sufficiently old to enable one to say what the life of Hevea may be, or even to state, with any degree of accuracy, the period over which a field of rubber trees will continue to yield a supply of latex sufficient to make it a paying proposition.

Yield from Bud-Grafted Hevea.—Comparative records of yields from budded and non-budded trees on Kajang and Sungei Reko Estates, Malaya, are given by F. G. Spring in *Malayan Agric. Journ.* (1926, **14**, 25). The mother trees, from which the buds were taken, were 13 years old and had given very high yields for a number of years. The budded trees were approximately four years old, from the time of cutting back the seedlings, and the controls (unbudded) were about five years old. The average girth of the latter was slightly above that of the budded trees. The trees were tapped during December 1925 and January 1926, and the results show remarkably higher figures in the case of the budded trees. From one set of 17 budded trees tapped on five occasions the average yield of dry rubber per tree per tapping was 16·3 grams ; from another set of 15 trees the average yield was 19·9 grams. From the 15 control trees the average yield was only 5·8 grams. It is recognised that the records are not on a sufficiently large scale to warrant any definite conclusion and further readings are to be taken.

Control of Wet-Root Rot Disease of Hevea.—An account of experiments conducted in Malaya on the control of wet-root rot disease is given by A. Sharples in *Malayan Agric. Journ.* (1926, **14**, 32). This disease, which is attributed to *Fomes pseudoferreus*, is one of the most serious diseases on mature rubber trees in Malaya. The method of spread appears to be by " root-contact," and since no mature fructifications have so far been found in the country, infection by spores cannot be of much significance. The usual method of preventing the

spread of root diseases, by means of isolation trenches, is apparently useless in the case of wet-root rot, and the treatment hitherto adopted in the case of heavy infection has been to isolate the whole of the infected area from the healthy parts of the estate by a continuous trench, without attempting to save individual trees by connecting trenches. The disease commences at the tips of the lateral branches and spreads towards the trunk. The method of control described consists of cutting out badly diseased trees, and in the case of all others, tracing out those lateral roots which occur within nine inches of the surface and severing any portion found to be attacked. (Investigation showed that the disease is confined to lateral roots growing in the uppermost nine inches of soil.) By cutting out diseased roots in this way valuable trees can be saved, even though already infected. On one estate 753 trees were examined over a period of five months. Of these, 356 were found to be healthy; in 185 cases the trees were treated by severance of the lateral roots and 212 were badly diseased and were cut out. A total of approximately $2,250 was spent on this work, but in view of the fact that 185 trees were saved, which otherwise might in time have been ruined and have formed a centre of infection for healthy trees, it is considered that the method is one which is worth adopting. It is emphasised, however, that the method is only likely to be economically sound if the disease is tackled in the earlier stages.

Wild Guttas and Rubber of South-Eastern Borneo.—In *Tectona* (1926, **19**, 1), E. van der Laan and L. van Meurs give a list of the wild gutta and rubber-yielding plants occurring in the South-eastern Province of Dutch Borneo, including the various native names under which the products are known, and the botanical sources where these have been determined. The products include "Geta merah," furnished by forms of *Palaquium Gutta*, Burck., and by *Payena Leerii*, Kurz; "Hankang," derived from species of *Palaquium*, including *P. leiocarpum*, Boerl., and *P. quercifolium*, Burck.; "Katiau," produced by *Ganua* (*Bassia*) *Motleyana* Pierre, var. *latifolia*, H. J. Lam; jeleutong from *Dyera laxiflora*, Hook. f., *D. Lowii*, Hook. f., and *Alstonia* sp.; and various rubbers from species of *Willughbeia*, *Ficus*, and *Artocarpus*. In the case of jeleutong, hankang and katiau, an account is given of the methods of tapping the trees and coagulating the latex, together with a description of the guttas and figures of exports and prices. The quantities exported from the South-eastern Province in 1924 were as follows:—Jeleutong 1,776 metric tons, hankang 1,212 metric tons, katiau 899 metric tons. The material is consigned chiefly to the United States and Singapore. From an estimate of the existing forest resources, the authors conclude

that the present production is far below the possible maximum, and consider that there is no necessity to enforce protecting regulations or to have recourse to cultivation.

Further particulars regarding katiau are given in an article by C. N. J. Delmaar in *Tectona* (1926, **19**, 142).

TOBACCO.

Ceylon.—*The Year Book of the Dept. Agric., Ceylon,* 1926 (p. 24), contains a report on the progress of White Burley tobacco cultivation in the Jaffna Peninsula, with special reference to the seasons 1923–24 and 1924–25.

In 1920 a scheme was initiated by which the Department of Agriculture purchased from the native cultivators tobacco of the White Burley variety grown in the Jaffna Peninsula from seed and seedlings distributed by the Department. At first the Department undertook to purchase the crop, up to a limit of 20,000 plants, at rates of from 8 to 20 cents per plant. The plants so purchased were cured in the Experiment Station curing sheds and the tobacco subsequently packed into wooden boxes and shipped to London for sale. In 1924, as the cultivation had increased and the growers had become experienced in the curing of this class of tobacco, the more satisfactory system was adopted of purchasing the tobacco as cured leaf at rates of from 75 cents to 90 cents per lb. A new method of packing was tried in 1925, the leaf being put up in bales of 220 lb. each, tightly wrapped in palmyra mats and corded, instead of being pressed into wooden boxes. The total number of cultivators rose from 2 in 1920 to 224 in 1925, the area under cultivation in the latter year being 32 acres. The yield of cured tobacco was 169 lb. in 1920 and 14,131 lb. in 1925. During the last two seasons there was a slight loss on the sale of the tobacco in London, but this is attributed in the main to the unfavourable rate of exchange. The selling price in London was 1*s*. 7*d*. per lb. in 1924 and 1*s*. 5*d*. to 1*s*. 7*d*. per lb. in 1925.

Southern Rhodesia.—E. M. Matthews, the newly appointed Tobacco Adviser in Southern Rhodesia, contributes an article on the tobacco industry in that Colony to the *Rhod. Agric. Journ.* (1926, **23**, 253). He comes from one of the principal tobacco-producing centres of Virginia, and in his opinion the Rhodesian product compares favourably with the world-famous "Virginia" tobacco; in fact, he sees no difference in the quality of the two products from the standpoint of either the market or the consumer. Of the three principal types grown in Rhodesia, viz. flue-cured, fire-cured and Turkish, the first-named is at present by far the most important. There are, however, soils in the Colony which should be very suitable

for the production of fire-cured tobacco and with a fairly promising export market for this product it is believed that it will become of much greater importance in the future. Large areas of cheap land with suitable soils and cheap labour are available, and Mr. Matthews considers that there is no reason why the present Rhodesian production of about three million pounds annually, should not be increased five to tenfold. The greatest handicaps experienced in tobacco growing in Southern Rhodesia are the uncertainty and irregularity of the seasons, with respect to rainfall in particular, and the increasing shortage of fuel in some areas. In addition, diseases such as wild-fire and angular-spot have caused damage in the past, but competing countries also suffer in this respect, the loss from these two diseases, for example, in the State of Virginia alone in 1920, being estimated at between one and two million pounds sterling. Of the difficulties mentioned, all but the first-named can be eliminated. Afforestation with suitable trees where timber is scarce will remedy the fuel shortage, and by using every precaution, such as proper crop rotation, seed selection, seed treatment, and sterilisation of seed bed and seed cover to prevent the spread of bacterial diseases, their damage may be almost eliminated.

The same issue of the *Journal* also contains an article giving full practical directions for the harvesting and curing of Virginia tobacco (p. 205), and another on tobacco mosaic disease in Southern Rhodesia, with special reference to the possibility of breeding resistant varieties (p. 248).

Union of South Africa.—According to the report of the Acting Chief of the Tobacco and Cotton Division of the Union Department of Agriculture for 1924–5 (*Journ. Dept. Agric., Un. S. Afr.*, 1925, **11**, 558), the production of tobacco in South Africa in 1923-4 was approximately 11,750,000 lb., which shows a decline from the previous year. The spring of 1923 was at first very dry and it was difficult to obtain good stands; in many cases the lands had to be replanted three times. During the curing season, continuous rains caused a large percentage of the leaf to be dark and of low grade. The 1924–5 crop, although having suffered from heavy rains, was of better quality. The Turkish tobacco crop suffered heavily from damage by wild-fire disease and consequently the quality was not up to the usual standard. Owing to the spread of this disease a pathologist of the Division of Botany has been appointed specially to investigate the problem, particularly in relation to the life of the bacterium in the winter, the method of infection in spring and possible control measures. The transmission of infection by the seed and the question of seed treatment are also under consideration.

Gums and Resins.

Natural Varnishes of Indo-China.—An interesting article on this subject has appeared in *Bull. Économique de l'Indochine* (1925, **28**, 475). Tonkin lacquer is derived from *Rhus succedana* Linn., var. *Dumontieri*, Pierre, a tree normally 8 to 10 metres high, but which when under cultivation and frequently tapped attains the height of only 3 to 4 metres. No great care is exercised in the cultivation of this tree which is propagated from seed. The young plants are given a dressing of buffalo manure for the first three years. They then begin to be productive and continue to yield latex until the sixth or seventh year, and are then cut down. In the fifth year a new plantation is generally sown to prevent any break in the production. The trees are stated to be free from attack by insects and diseases. They are tapped mostly by women and children at intervals of 2 to 5 days all the year round, rainy weather being avoided. Commencing at the base of the trunk large V-shaped incisions are made in the bark, which half or three-quarters encircle the trunk. Mussel shells are employed to catch the exuding latex. The incisions which are made in the early morning must be shaded from bright sunlight as this induces oxidation. In the region of Thanh-ba, a tree is estimated to yield about 600 grams annually, or approximately 1,800 kilos. per hectare of 3,000 trees. The latex is stored for a year or more in special baskets and is protected from light and air. The lacquer then separates into four or five well recognised layers differing in quality chiefly according to the amount of water present. The most valuable portion is the surface layer which is almost free from water and has the colour of café-au-lait. The next two layers constitute the bulk of the marketable lacquer. These contain respectively 15 to 25, and 40 to 45 per cent. of water.

The properties of Tonkin lacquer resemble those of the Japanese lacquer, *Rhus vernicifera*, DC. While asserting the superiority of their own lacquer for works of art, Japanese chemists consider Tonkin lacquer excels all paints for ships' hulls, and has the additional advantage of resisting incrustation with barnacles. It is said, moreover, that paper, cloth, or leather coated with this lacquer can be folded and refolded without cracking the film. Although Tonkin lacquer was practically unknown in France before the war, it is said to have been used there for aeroplane propellers during the war in preference to all other varnishes.

Owing to the fact that this lacquer is not classed separately in the trade returns it is not possible to give accurate figures for the annual amount produced and exported. It may be roughly estimated at 600 tons, a third of which is used in the Colony itself, and the remainder divided equally between China and Japan.

The price of Tonkin lacquer during recent years has varied considerably; at the end of 1924 it ranged from about £13 8*s.* to £31 10*s.* per cwt. according to the amount of water present.

Cambodia lacquer is chiefly derived from *Melanorrhoea laccifera,* Pierre, and *M. usitata,* Wall, trees 15 to 20 metres high. The sap is collected in bamboo tubes placed underneath incisions made in the bark. Cambodia lacquer is used to some extent locally as a varnish but does not appear to be exported. It is stated to be inferior to Tonkin lacquer and to furnish a less lustrous coat; its properties, however, have not been thoroughly investigated.

Copal.—As the result of throwing open for tapping, reserves and restricted areas in Sierra Leone, 68,203 lb. of copal resin, valued at £4,382, were exported in 1924. This is an increase of 17,055 lb. over the amount exported in 1920 when tapping was last permitted. The yield of resin has increased as a result of the measures taken to protect the trees against the uncontrolled and destructive tapping formerly practised (*Ann. Rep. Lands and For. Dept., Sierra Leone,* 1924).

FORESTRY AND TIMBERS.

Burma Forests and Forest Resources.—In an account of the growth of the present forestry organisation in Burma and its methods of management and working (*Empire Forestry Journal,* 1925, **4**, 251), A. H. M. Barrington, Conservator of Forests, Burma, briefly describes the types of forest occurring in the country and refers to the principal commercial species of each. An almost pure forest of sundri (*Heritiera fomes*) occurs in the tidal swamps, while the usual type of evergreen forest is characterised by dipterocarps with species of Dipterocarpus, Hopea, Parashorea, Anisoptera and Shorea in the overwood. In the moist forest the predominant tree is pyinkado (*Xylia dolabriformis*), with which are associated *Homalium tomentosum, Gmelina arborea, Schleichera trijuga,* and various Leguminosae. The teak forest is by far the most important of the country, its general distribution being determined by rainfall (40–80 inches), elevation (up to 3,000 ft.) and soil. The forest growth is usually associated with pyinkado and *Bambusa polymorpha,* but other species also occur. In the dry forest the most important type is pure in or eng (*Dipterocarpus tuberculatus*). The author states that the quality of the forest and even the distribution of species has been greatly modified by the practice of shifting cultivation. The clearings made for rice cultivation if quickly abandoned become covered with fire-hardy species (including teak), but if the clearings are repeated at short intervals (5, 10 or 15 years) the tendency

is for tree species to give place to bamboos. The largest bamboo "brake" is composed of *Melocanna bambusoides* and is probably 10,000 square miles in extent.

As a preliminary to the stock-mapping by aeroplane of the forests of the Tavoy and Mergui Districts of Burma (i.e. the South Tenasserim Forest Division) a ground inspection of some of these forests was carried out by Mr. C. W. Scott and Mr. C. R. Robbins of the Indian Forest Service, and these officers' reports have been printed as *Burma Forest Bulletin No.* 14, *Silvicultural Series No.* 10, 1925.

The chief areas inspected by Mr. Scott were parts of the Heinze Kaleinaung reserves and adjoining forest, of the drainages of the Little Tenasserim river, Ngawun chaung and Lenya river, and of the coastal drainage east and south of Bokpyin. The forests inspected are classified by him into a number of types. Considered as a practical source of supply of timber, the riverine forest of the Ngawun valley is the most promising of the areas visited, the timbers chiefly noted in this area being pyinma (*Lagerstroemia Flos-reginae*), thitka (*Pentace burmanica*), kanyin (*Dipterocarpus* spp.), tagu (*Litsaea* sp.), and thingan (*Hopea* spp.). Parts of the heavy evergreen type of forest bordering upon the Tenasserim river and some of its tributaries are also worth investigating from the point of view of timber supplies. The principal timbers likely to be obtainable in that area are stated to be kanyin, gangaw (*Mesua ferrea*), thitka, pyinma, thingan and tagu.

Bamboo is plentiful in the Lenya valley and in the valleys of the Big and Little Tenasserim rivers, and its possibilities as a source of paper pulp are worth considering; limestone is available in the Ngawun valley.

Among Tenasserim timbers the best market in England is for thitka. Kanyin has a limited market in Rangoon, which should be developed in view of the large quantities present in the forests. It should also be possible to find markets for thingan and pyinma, both of which are very fine timbers, as well as for gangaw which is abundant in Mergui and is well known in India. In considering the possibility of exploiting the resources of these forests on any considerable scale it must be borne in mind that most of the labour would have to be introduced from outside, and that malaria is bad in many places.

Mr. Robbins's investigations, which were more rapidly and less thoroughly carried out than those of Mr. Scott, included forests in the vicinity of the Big and Little Tenasserim rivers and the Thagyet chaung, and others neighbouring the Pakchan river. In both these areas the hill evergreen type of forest is the most important. The first of the two areas was not regarded as promising commercially; no single species is especially

common but several would have to be worked, those indicated being gangaw, kanyin, thitka, kaunghmu (*Parashorea stellata* ?), and thingan. In the hill evergreen forests of the second area visited the most prominent species is gangaw, and the opinion is expressed that the forests could be made commercially payable if a good market were found for this timber.

Forestry in Victoria.—In the *Sixth Annual Report* (1924–25) of the Forests Commission of Victoria, attention is drawn to the growing public interest in the forest problems of that State. The most important evidence of such interest was the Parliamentary sanction of a Forest Loan of £500,000, to be expended over a period of five years, for the systematic development, improvement, conservation and establishment of forests, both of indigenous hardwoods and of introduced softwood species. A further important event was the addition to the permanent forests of the State of an area of some 179,000 acres of lands along the River Murray. These lands, which are unsuited for settlement on account of their periodical inundation, are timbered with red gum (*Eucalyptus rostrata*) and black box (*E. bicolor*) and are regarded as an invaluable reserve of high-grade timber and fuel for the north-west area of Victoria. The Commission is adopting a policy of planting exotic softwoods in view of the absence of softwood forests in the State and the suitability of considerable areas of waste land for raising certain softwood species. So far experience shows that *Pinus insignis* is admirably adapted to local conditions of soil and climate, and is a rapid grower. Where conditions permit, species yielding timber of greater intrinsic value are being grown, but suitable areas are comparatively limited. It is highly satisfactory, therefore, that over large districts of land which is among the poorest in the State it is possible to grow *Pinus insignis*, which yields a timber eminently serviceable for a variety of purposes even though not regarded as a timber of the first class.

Timbers in Netherlands Indies.—*Mededeelingen van het Proefstation voor het Boschwezen*, No. 11, Deel I, (1925) issued by the Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië, and entitled "Belangrijke Houtsoorten van Nederlandsch-Indië," is the first of a series of publications intended to present useful information regarding the woods of the Netherlands Indies in a form suitable for timber merchants, timber users, forestry officers, etc. It gives the systematic, native, and trade names, anatomical and other characteristics, physical and mechanical properties, uses, etc., of a large number of woods. An accompanying *Platenatlas* contains 60 photo-micrographs of sections of woods dealt with in the main publication.

No. 12 of the same *Mededeelingen* (1925), entitled "Kultuurproeven met Industrie-, Konstruktie-, en Luxe-houtsoorten," contains the results of sylvicultural experiments and observations on a number of timber trees in the Netherlands Indies.

A Teak Disease.—In *Tectona* (1926, **19**, 31), T. Altona gives an account of the damage to teak in Java caused by the fungus *Corticium javanicum*, Zimm. (*C. salmonicolor*, B. et Br.), known locally as djamoer-oepas, and familiar as the cause of the "pink disease" of rubber. In West and Central Java teak plantations were found in which 15 per cent. to 20 per cent. of the trees were attacked by the disease, and unfavourable conditions are known to result in more than twice this percentage of cases. In ordinary circumstances the effects of the disease are limited to the formation of holes or fissures in the bark, which in most cases disappear later without causing permanent injury to the tree. Only in special conditions does the fungus cause the dying back of branches or stems. The disease occurs in both old and young plantations and appears to be commonly associated with hollow trees, 73 per cent. of diseased trees included in one enumeration being hollow. As preventive measures it is suggested that teak should not be planted with other species susceptible to the disease, and that the trees should be planted at comparatively wide distances and thinned early. Removal of infected trees appears to be the only way of repressing the disease.

Kiln Drying of Timber.—There has recently been received a copy of a report of a course of ten lectures on the kiln drying of timber delivered in Melbourne by Harry D. Tiemann under the auspices of the Victorian Forests Commission in 1921 and 1922. It is unnecessary to emphasise the value of an account of this important subject by so distinguished an expert, and it will be sufficient to recommend this publication as affording an admirable statement in non-technical language of the position of kiln drying at the time mentioned. In addition to a discussion of fundamental subjects in the introductory lectures, the ground covered during the course comprised an account of the construction and action of the chief types of kiln, the instruments employed in working them, and the methods adopted in practice in drying timber for commercial purposes. The treatment of these technical subjects is both interesting and highly instructive, and the record of replies to questions put to the lecturer is a valuable feature. The concluding lecture is devoted to a comparison of forestry conditions in Victoria and the United States and includes a short account of the organisation and working of the fire prevention patrols in America. The report is illustrated with a number of diagrams including a typical "humidity diagram."

Attacks of Boring Beetles on Australian Timbers.—Some observations relating to the attacks of the boring beetles *Lyctus* and *Anobium* on Victorian indigenous timbers, made by the Technological Museum, Melbourne, are recorded in the *Australian Forestry Journal* (1925, **8**, 319). The beetles concerned are stated to be *Lyctus brunneus*, another species of *Lyctus* and *Anobium punctatum*, but in view of confusion in nomenclature they are referred to by their generic names only. Deductions as to the attacks on different timbers were made from observations of borings, though it was not always possible to be certain whether Lyctus or Anobium had been responsible, and in some cases both appeared to have been at work.

With nearly all the species of timber observed, the attacks of both insects were found to be confined to sapwood and unsound wood. It has been reported that some commercial Victorian timbers have shown signs of attack in the heartwood, but the present observations do not confirm this as being of general occurrence so far as the two insects under consideration are concerned. The report is attributed to the absence, in some cases, of clear distinction between heartwood and sapwood, or to the heartwood of a plank having been slightly bored by insects working in a piece of infected timber in close contact with it, or to the work of an adult beetle in finding an exit from infected timber. In some cases observed, holes in heartwood were found to be due to other kinds of beetle which bore indiscriminately through heartwood and sapwood before the wood is dry.

It would appear that Lyctus commonly starts working in timber very soon after it is cut, whereas Anobium does not attack till later. This may be due to the necessity for the sapwood to undergo certain chemical changes before it becomes attractive to the latter beetle, or to that insect's greater preference for dark places, where the timber is less likely to be found till some time after it has been sawn or manufactured.

There are indications that the attacks of Lyctus tend to become less with the increasing age of the timber, but the beetle was found at work in timber not less than 40 years old, and Anobium was observed in sapwood over 50 years old, so that for practical purposes the age of the wood cannot be regarded as conferring upon it any immunity. The age of the tree from which the timber is cut, however, is of influence, timber taken from old and sound trees being less readily attacked than that cut from young trees of the same kind.

Observations are recorded as to the relative extents to which different timbers are liable to attack, but it is pointed out that in view of the various factors of uncertainty noted above, any such deductions may later require revision. Furthermore, great caution is necessary in declaring any

particular timber to be actually immune, since it has been found that one piece of timber may show no signs of attack whilst another piece of the same species, in close proximity, may be badly affected.

For particulars regarding all the timbers examined, reference must be made to the original. It may, however, be noted here that timbers of the genus *Callitris* (cypress pines) appeared to be entirely immune from attack. *Avicennia officinalis* (white mangrove) was free from infection, as were also *Phebalium Billardieri* (*Eriostemon squameus*), *Exocarpus cupressiformis* (native cherry), *Pittosporum undulatum*, *P. bicolor*, species of *Leptospermum*, *Melaleuca ericifolia*, and *M. squarrosa*. Other timbers examined were attacked to a greater or less degree, *Nothofagus* (*Fagus*) *Cunninghamii* being amongst those found to be particularly susceptible. The Eucalypts are regarded generally as being all more or less susceptible, observations indicating that in the case of this genus the attacking beetle is for the most part Lyctus, though in the case of other woods Anobium appears to be generally the greater offender.

BIBLIOGRAPHY.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, March–May 1926.

The publications issued by the Governments of the Crown Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

Agriculture

General

Year-book of the Department of Agriculture, Ceylon, 1926. Pp 62, 10 × 7½. (Peradeniya: Department of Agriculture, 1926.)

Report on the Operations of the Department of Agriculture, Punjab, for the Year ending June 30, 1924. Part II. Annual Record of Experimental Work. Vol. I. Economic Botany, Agricultural Chemistry, and Entomology and Sericulture. Pp. 90, 13 × 8½. Vol. II. Experiment Stations. Pp. 175, 13 × 8½. (Lahore: Superintendent, Government Printing, 1925.) Price, Vol. I, Rs.5, As.4 (7*s.*); Vol. II, Rs.5, As.12 (7*s.* 8*d.*).

Bulletin du Département de l'Agriculture et de la Pêche, Seychelles, No. 6, 1926. Pp. 12, 13 × 8½. (Victoria, Mahé: Government Printing Office, 1926.) [Includes notes on coconut industry, palmarosa and vetiver oils, kapok and fisheries.]

Agricultural Census of the Colony and Protectorate of Kenya. Sixth Annual Report, 1925. *Dept. Agric., Kenya.* Pp. 44, 9½ × 6. (Nairobi: Kenya and Uganda Railway Press, 1926.)

Fourth Annual Bulletin of the Agricultural Department, Nigeria. Pp. 217, 10½ × 8. (Lagos: Government Printer, 1925.) Price 5*s*.

Annual Report of the Lands and Forests Department, Sierra Leone, for the Year 1924. Pp. 60, 13 × 8½. (Freetown: Government Printing Office, 1926.)

Report of the Department of Agriculture, Tanganyika Territory, for the Year 1924–5. Pp. 45, 13 × 8. (Dar-es-Salaam: Government Printer.)

Proceedings of the Ninth West Indian Agricultural Conference, Kingston, Jamaica, January 1924. Pp. 238, 9½ × 6. (Jamaica: Government Printing Office, 1925.) Price 2*s*. 6*d*.

Minor Industries for the Leeward Islands. By A. E. Collens and F. H. S. Warneford. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 105–119.

Report on the Agricultural Department, Antigua, 1924. Pp. 19, 13 × 8½. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1925.) Price 6*d*.

Report on the Agricultural Department, Dominica, 1924–5. Pp. 34, 13 × 8½. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1926.) Price 6*d*.

Report on the Agricultural Department, St. Lucia, 1924. Pp. 30, 13 × 8½. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1926.) Price 6*d*.

Report on the Agricultural Department, St. Kitts–Nevis, 1924–5. Pp. 41, 13 × 8½. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1925.) Price 6*d*.

Annual Report of the Department of Agriculture, New Brunswick, for the Year ending October 31, 1925. Pp. 152, 10 × 6¾. (Fredericton, N.B., 1926.)

Report of the Department of Agriculture, New South Wales, for the Year ended June 30, 1925. Pp. 33, 13 × 8½. (Sydney: Government Printer, 1926.) Price 2*s*. 3*d*.

Annual Report of the Department of Agriculture, Fiji, for the Year 1924. Pp. 14, 13 × 8½. *Council Paper No.* 44, 1925. (Suva: Government Printer, 1925.)

Agriculture et Industries Indigènes dans le Développement Économique du Congo Belge. By É. de Wildeman. [A paper presented to the Congrès Colonial Belge, Feb. 6–7, 1926.]

Considerations sur l'état actuel des Connaissances relatives à la géobotanique du Congo Belge. By É. de Wildeman. Pp. 43, with Map. 9½ × 6½. (Brussels: King's Printer, 1925.) [Reprint from *Rev. Gen. de la Col. Belge*, May–June 1925.]

The Fertility of Egypt. By V. M. Mosséri. *Int. Rev., Sci. and Pract. of Agric.* (1926, **4**, N.S., 1–9.)

La Società Agricola Italo-Somala in Somalia. [Deals with climate, soils, labour supply, colonisation, cultivation of crops, experimental work, etc., in Italian Somaliland.] By G. S. Sforzolini. *Agric. Col.* (1926, **20**, 121–191).

Mission d'études aux Indies-Néerlandaises. By Y. Henry. *Bull. Écon. Indochine, N.S.* (1925, **28**, 543–586).

Die natürlichen Grundlagen und die gegenwärtigen Verhältnisse der landwirtschaftlichen Produktion in Chile. By H. Anderson. *Beiheft zum Tropenpflanzer* (1925, **22**, No. 2, pp. 55–145).

Calapogonium mucunoides. Some Practical Hints on Planting and Maintenance. By S. H. Smith. *The Planter, Malaya* (1926, **6**, 215–217, 240).

The Effect of Straw on Plant Growth. By R. C. Collison and H. J. Conn. *Tech. Bull. No.* 114, *New York State Agric. Exper. Sta.* Pp. 35, 8¾ × 5¾. (Geneva, N.Y.: Agricultural Experimental Station, 1925.)

The Soil.

Soil Investigations and their Bearing on Field Experimental Work. By W. G. Ogg. *Scottish Journ. Agric.* (1926, **9**, 20–33).

The Fertility of the Soil, especially in Connection with the Cultivation of Perennial Crops. By A. W. K. de Jong. *Communications from the Gen. Exper. Sta. of the A.V.R.O.S., Gen. Ser. No.* 23. Pp. 30, 10½ × 7½. (Medan : Varekamp & Co., 1925.)

Causes of Infertility in Soils in Relation to Bacterial Action. By C. M. Hutchinson. *Agric. Journ., India* (1926, **21**, 125–133).

Soil Erosion. By F. A. Stockdale. Soil Erosion Experiments on the Experiment Station, Peradeniya. By T. H. Holland. *Year-book Dept. Agric., Ceylon*, 1926, pp. 3–6.

"Ephos" Phosphate and Superphosphate. Their Relative Effect upon the Wheat Crop at the Merredin Experiment Farm, Western Australia, 1925. By. G. L. Sutton. *Journ. Agric., W. Aust.* (1926, **3**, 2nd Ser., 115–119).

The Influence of Superphosphate upon the Germination of certain Small Seeds. By W. R. Birks. *Journ. Agric., S. Austr.* (1926, **29**, 606–634).

The Determination of available Phosphoric Acid of Calcareous Soils. By Surendralal Das. *Mem. Dept. Agric., India, Chem. Ser.* (1926, **8**, 69–104).

On the Use of Manure as Fuel. By P. E. Lander and M. Mukand Lal. *Agric. Journ., India* (1926, **21**, 115–124).

Insect Pests—General.

Report on the Occurrence of Insect Pests on Crops in England and Wales for the Years 1922, 1923 and 1924. *Misc. Publ. No.* 49, *Min. Agric. and Fish.* Pp. 35, 9½ × 6. (London : H.M. Stationery Office, 1925.) Price 1*s.* 6*d.*

Report of the Entomologist, Mandalay, and Sericultural Work, Burma, for the year ended the 30th June 1925. Pp. 10 + 8, 9¾ × 6¼. (Rangoon : Superintendent, Government Printing, 1925.) Price As.4 (5*d.*).

The Spotted Locust, *Aularches miliaris*, L. By J. C. Hutson. *Year-book, Dept. Agric., Ceylon*, 1926, pp. 36–44.

The Slug Pest. *Rep. No.* 143, *Univ. of Leeds and Yorks. Counc. for Agric. Educ.* Pp. 14, 8½ × 5½. (Leeds : Agricultural Department, The University, 1926.)

Plant Diseases—General.

Annual Report of the Mycologist, Department of Agriculture, Burma, for the year ended the 30th June 1925. Pp. 6, 9¾ × 6¼. (Rangoon : Superintendent, Government Printing, 1926.) Price As.2 (2*d.*).

Les maladies bactériennes chez les Graminées. By L. Guyot. *Rev. Bot. App. et d'Agric. Col.* (1925, **5**, 920–925).

Foodstuffs—General.

Maori Agriculture. The Cultivated Food Plants of the Natives of New Zealand, with some account of Native Methods of Agriculture, its Ritual and Origin Myths. By Elsdon Best. *Bull. No.* 9, *Dominion Museum, New Zealand.* Pp. viii + 172, 11 × 8½. (Wellington : Dominion Museum, 1925.)

The Food Plants of Porto Rico. By O. W. Barrett. *Journ. Dept. Agric., Porto Rico* (1925, **9**, 61–208).

Sclerotinia spp., causing decay of vegetables under transit and market conditions. By G. B. Ramsey. *Journ. Agric. Res.* (1925, **31**, 597–632).

Beverages.

The Cacao Problem in Saint Lucia. By A. E. Walters. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 69–71.

Kakao auf Samoa. *Gordian* (1926, **31**, 3786–3790).

Studies in Cacao. The Method of Pollination. By S. C. Harland. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 61–69.

El Status de la Industria Cafetera en Colombia, S.A. By C. A. Figueroa. *Rev. Agric. Puerto Rico* (1925, **15**, 7–15 ; 128–132).

Notes on the Coffee Berry-borer (*Stephanoderes hampei*, Ferr.) in Uganda. By H. Hargreaves. *Bull. Entom. Res.* (1926, **16**, 347–354).

Reports on the Visit of the Ceylon Delegation to the Tea Districts of North India. By F. A. Stockdale, M. L. Wilkins and J. Horsfall. *Trop. Agric., Ceylon* (1926, **66**, 67–89).

The World's Largest Tea Property. [An account of the work of the Anglo-Dutch Plantations Co., Ltd., in Java and Sumatra.] *Tea and Coffee Trade Journ.* (1926, **50**, 448–452).

The Effect on Tea Crop of a Leguminous Crop while Growing. By H. R. Cooper. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1925, Part IV, pp. 127–137).

Indigofera endecaphylla as a Cover Crop for Tea. By T. H. Holland. *Year-book, Dept. Agric., Ceylon*, 1926, pp. 13–15.

A note on Branch Canker of Tea. By C. H. Gadd. (*loc. cit.*, pp 7–8).

A Leaf Disease of Tea caused by *Macrophoma theicola*, Petch. By C. H. Gadd and C. Ragunathan. (*loc. cit.*, pp. 16–18).

Cultivo de la Yerba Mate en la República Argentina. Estadística de las plantaciones. Informaciones de los Plantadores. Cuarta Encuesta, 1924. By C. D. Girola. *Publ. No.* 47, *Museo Agricola, Buenos Aires.* Pp. 73, 10½ × 7½. (Buenos Aires: Imprenta "Gadola," Rivadavia 775, 1925.)

Cereals.

Report of the Dominion Cerealist, Department of Agriculture, Canada, for the Year 1924. Pp. 31, 9¾ × 6½. (Ottawa: King's Printer, 1926.)

The Institute of Brewing Research Scheme. Third Report on the Experiments on the Influence of Soil, Season and Manuring on the Quality and Growth of Barley, 1924. By Sir E. J. Russell. *Journ. Inst. Brewing* (1925, **31** (**22**, N S.), 548–561).

The Institute of Brewing Research Scheme. Third Report on the Influence of Soil, Season and Manuring on the Quality and Growth of Barley of the 1924 crop, as indicated by the malts made therefrom. By H. M. Lancaster. With Appendices on Malting Results by H. M. Lancaster, and Analytical Results by H. Ll. Hind (*loc. cit.*, pp. 601–608).

Tests of Barley Varieties in America. By H. V. Harlan, M. L. Martini and M. H. Pope. *Dept. Bull. No.* 1334, *U.S. Dept. Agric.* Pp. 219, 9¼ × 6. (Washington: Government Printing Office, 1925.) Price 30 cents.

Proceedings of the Maize Export Conference, Rhodesia, 11th March 1926. *Rhod. Agric. Journ.* (1926, **23**, 349–356).

Ear Rot of Maize (*Diplodia Zea*). By H. Tryon. *Queensland Agric. Journ.* (1926, **25**, 237–258).

Contribution à la Sélection des Riz dans le Centre de Madagascar. By J. Delpon. *Riz et Riziculture* (1925–26, **1**, 373–393).

La Culture du Riz en Chine. By C.-O. Levine. *Riz et Riziculture* (1925–26, **1**, 415–420).

Experiments in Rice Production in South-western Louisiana. By C. E. Chambliss and J. M. Jenkins. *Dept. Bull. No.* 1356, *U.S. Dept. Agric.* Pp. 32, 9 × 6. (Washington: Government Printing Office, 1925.)

La traitement du riz à l'usine. By R. Aubert. *Bull. Écon., Madagascar* (1925, pp. 99–106).

Contribution à l'Étude Biologique des Riz. Atlas Iconographique des Riz. Structure des organes végétatifs et floraux du Riz à l'état adulte. By R. Heim de Balsac. *Riz et Riziculture* (1925–26, **1**, 427–433).

Note sur une chenille dévastatrice du riz (*Leucania unipuncta*, How.). *Bull. Écon. Indochine, N.S.* (1925, **28**, 587–592).

Rye. By H. W. Hilliard. *Rhod. Agric. Journ.* (1926, **23**, 342–345).

Wheat-Breeding Investigations at the Plant Breeding Institute, Cambridge. By Sir R. H. Biffin and F. L. Engledow. *Res. Mon. No. 4, Min. Agric. and Fisheries.* Pp. 114, 9½ × 6¼. (London: H.M. Stationery Office, 1926.) Price 2*s.* 6*d.* (paper covers); 4*s.* (cloth), post free.

Relative Susceptibility of Spring-Wheat Varieties to Stem Rust. By J. A. Clark, J. H. Martin and E. C. Stakman. *Dept. Circ.* 365, *U.S. Dept. Agric.* Pp. 17, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Comparative Hardiness of Winter-Wheat Varieties. By J. A. Clark, J. H. Martin and J. H. Parker. *Dept. Circ.* 378, *U.S. Dept. Agric.* Pp. 19, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Report of Seed-Pickling Trials conducted at Roseworthy Agricultural College, South Australia. By A. T. Jefferies. *Journ. Dept. Agric., S. Austr.* (1926, **29**, 709–715).

Downy Mildew of Wheat (*Sclerospora macrospora*, Sacc.). By R. J. Noble. *Agric. Gaz., N.S.W.* (1926, **37**, 204–208).

Sugar

The Sugar Industry, with special Reference to the West Indies. Address by Sir Francis Watts, before a joint meeting of the Agricultural Society of Trinidad and Tobago and the Trinidad Chamber of Commerce. *Proc. Agric. Soc., Trinidad* (1926, **26**, 2–14).

Report on Experiments with Varieties of Sugar-cane, conducted in Antigua, St. Kitts, Nevis and Montserrat, in the season 1923–4. Pp. 51, 9½ × 6. (Barbados: Issued by the Imperial Commissioner of Agriculture for the West Indies, 1926.) Price 1*s.*

Report on the Sugar-cane Experiments for the Season between 1923–5. Department of Agriculture, Barbados. Pp. 23, 13 × 8¼. (Barbados: Government Printer, 1926.)

The B H 10 (12) and S C 12 (4) Canes. Some observations on these two promising varieties in the West Indies. By A. H. Rosenfeld. *Journ. Dept. Agric., Porto Rico* (1925, **9**, 215–247).

Varieties of Sugar-cane in Queensland. By H. T. Easterby. Second edition. Pp. 37, 9¾ × 6¼. (Brisbane: Government Printer, 1926.)

Zuckerrohrkultur mit künstlicher Bewässerung auf Hawaii. By H. Habrecht. *Tropenpflanzer* (1926, **29**, 46–70; 85–97).

L'usine à Sucre à la Martinique. *Bull. Ag. Gén. des Col.* (1926, **19**, 3–17).

Studies in Sugar-cane Germination. By Rao Sahib T. S. Venkatraman. *Agric. Journ., India* (1926, **21**, 101–106).

Mosaic Disease of Sugar-cane. By C. G. Hansford. *Proc. 9th W. Ind. Agric. Confer.* (1924, pp. 76–82).

Three serious Cane Diseases not yet reported from the British West Indies. [Gumming, Gum Disease or Cobb's Disease; Fiji or Leaf Gall Disease; Leaf Stripe or Sclerospora Disease.] By S. F. Ashby. *Proc. 9th W. Ind. Agric. Confer.* (1920, pp. 84–89).

Notes on Queensland Cane Insects and their Control. Third Series. By E. Jarvis. *Bull. No.* 19, *Div. Entom., Bur. Sugar Exper. Sta., Queensland.* Pp. 72, 9¾ × 6. (Brisbane: Government Printer, 1926.)

Sugar Beet. The Results of an Inquiry into the Costs of Production, Yields and Returns in 1924. By A. Bridges and R. N. Fixey. *Res. Mon. No.* 3, *Min. Agric. and Fish.* Pp. 76, 9½ × 6. (London: H.M. Stationery Office, 1925.) Price 3*s.*

Sugar Beet at the University Farm, Cambridge. By A. Amos. *Journ. Min. Agric.* (1926, **33**, 26–33).

Root Crops.

Trials with Sweet Potatoes at Grafton Experiment Farm, N.S.W., 1924–5. By G. Nicholson. *Agric. Gaz., N.S.W.* (1925, **36**, 794–796.)

Production of Sweet Potato Seedlings at the Virgin Islands Experiment Station. *Bull. No.* 5, *Virgin Is. Agr. Exper. Sta.* Pp. 14, 9¼ × 6. (Washington: Government Printing Office, 1925.)

The Adobe Sweet Potato Storage House in Arizona. By F. J. Crider and D. W. Albert. *Bull. No.* 106, *Arizona Agric. Exper. Sta.* Pp. 18, 9 × 6. (Tucson: University of Arizona, 1925.)

Notes on the Sweet Potato Pyralid Moth (*Megastes grandalis*, Guen.). By J. W. Cowland. *Bull. Entom. Res.* (1926, **16**, 369–372).

Fruits.

Recent Investigations on Silver-leaf Disease. By F. T. Brooks. *Journ. Min. Agric.* (1925–26, **32**, 1128–1133.)

The Bronze Beetle. Its Habits and Control as an Orchard Pest. By D. Miller. *N.Z. Journ. Agric.* (1926, **32**, 9–14.)

The Control of Apple Scab. By N. B. Bagenal, W. Goodwin, E. S. Salmon and W. M. Ware. *Journ. Min. Agric.* (1926, **33**, 38–49).

The Control of the Apple Capsid Bug. By F. R. Petherbridge and W. G. Kent. *Journ. Min. Agric.* (1926, **33**, 50–57).

General Aspects of the Banana Industry of Jamaica. By H. H. Cousins. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 36–41.

Banana from Seed. Variety Experiments at the Imperial College of Tropical Agriculture. By J. S. Dash (*loc. cit.*, pp. 53–58).

Bunchy Top—what it is; how to detect it; what to do. By the Bunchy Top Investigation Committee. *Queensland Agric. Journ.* (1926, **25**, 259–262).

Some Remarks on Questions raised by the Panama Disease of Bananas. By C. G. Hansford. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 41–51.

Researches on Panama Disease. By S. F. Ashby (*loc. cit.*, pp. 51–53).

Ein neuer Bananenschädling auf den Kanarischen Inseln und seine Bekämpfung. By W. Ruschmann. *Tropenpflanzer* (1926, **29**, 97–100).

The Extension of certain Citrus By-Products (with particular reference to the Citrus Industry in Dominica). By F. H. S. Warneford. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 119–128.

Calcium Cyanide Dust for Fumigation of Citrus. Experiments to Determine Dosages. By J. M. Arthur and T. H. Harrison. *Agric. Gaz., N.S.W.* (1926, **37**, 245–248).

The Minimum Temperature for Growth of the Date Palm and the Absence of a Resting Period. By S. C. Mason. *Journ. Agric. Res.* (1925, **31**, 401–414).

Partial Thermostasy of the Growth Center of the Date Palm. By S. C. Mason (*loc. cit.*, pp. 415–453).

The Inhibitive Effect of Direct Sunlight on the Growth of the Date Palm. By S. C. Mason (*loc. cit.*, pp. 455–468).

Passion Fruit Culture. By A. H. Benson. *Queensland Agric. Journ.* (1926, **25**, 225–229).

Fodders and Forage Plants.

East African Pasture Plants. I—East African Grasses. Prepared at Kew Gardens for the Governments of Kenya, Uganda and Tanganyika Territory. Pp. 56, with 20 full-page illustrations and 8 other figures, 9½ × 6. (London: Crown Agents for the Colonies, 1926.) Price 2*s*. 6*d*.

Investigation on the Mineral Content of Pasture Grass and its Effect on Herbivora. By W. Elliot, J. B. Orr and T. B. Wood. I—General Report, by W. Elliot. II—Report on the Effect of the Addition of Mineral Salts to the Ration of Sheep, by W. Elliot and A. Crichton. III—Report on the Chemical Analyses of Samples of Pasture from various Areas in the British Isles, by W. Godden. IV—Report on the Seasonal Variations in the Mineral Content of Pastures, by E. M. Cruickshank. V—Report on the Effect of Fertilizers on the Mineral Content of Pastures, by W. Godden. *Journ. Agric. Sci.* (1926, **16**, 59–104).

The Growing of Lucerne. By C. Heigham. *Journ. Min. Agric.* (1925–26, **32**, 1089–1096).

Lucerne-Growing. Notes for Canterbury and North Otago Conditions. By F. E. Ward. *N.Z. Journ. Agric.* (1926, **32**, 15–25).

Wimmera Rye Grass. Trials in New South Wales. By J. N. Whittet. *Agric. Gaz., N.S.W.* (1926, **37**, 295–300).

Die Teparybohne (*Phaseolus acutifolius*). By J. C. Th. Uphof. *Tropenpflanzer* (1926, **29**, 43–46).

Forage Poisoning in Animals. By H. R. Seddon. *Agric. Gaz., N.S.W.* (1926, **37**, 183–188).

Plantas Tóxicas para los animales. *Circ. No.* 472, *Seccion Propaganda e Informes, Ministerio de Agricultura, Argentina.* Pp. 20, 9 × 6. (Buenos Aires, 1925.)

Nuttall's Death Camas (*Zygadenus Nuttallii*) as a Poisonous Plant. By C. D. Marsh, A. B. Clawson and G. C. Roe. *Dept. Bull. No.* 1376, *U.S. Dept. Agric.* Pp. 13, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Spices.

De Notemuskaatcultuur in Nederlandsch-Indië. Sedert de Opheffing van het Monopolie. By A. H. W. M. Hermans. Pp. 118, 9½ × 6. (Drukkerij van het Missiehuis, Steil bij Tegelen, L., 1926.)

Oils and Oil Seeds.

Le Ricin dans les Colonies Françaises. Notes présentées à la 3e Session de la Section des Matières Grasses du Conseil Supérieur des Colonies. *Bull. Mat. Grasses, Marseille* (1925, Nos. 11–12, pp. 294–301).

Esame chimico-tecnologico di semi di ricino provenienti dalla Cirenaica. By A. Ferrara. *Agric. Col.* (1926, **20**, 10–15).

Ricinus communis in Bahia and Brazil. By C. M. Chard. *Trop. Life* (1925, **21**, 161–163).

Pests and Diseases of the Coconut Palm in the Islands of the Southern Pacific. By H. W. Simmonds. *Bull. No.* 16, *Dept. Agric., Fiji.* Pp. 32, 9¾ × 6¼, with four coloured plates. (Suva: Government Printer, 1925.) Price 3*s*. 6*d*.

Diseases of Coconut Palms. By A. Sharples. *Malayan Agric. Journ.* (1926, **14**, 65–73).

Red Ring Disease of the Coconut. By S. F. Ashby. *Proc. 9th W. Ind. Agric. Confer.*, 1924, pp. 164–172.

The African Oil Palm. By H. A. Deutrom. *Year-book, Dept. Agric., Ceylon*, 1926, pp. 34–35.

Considerations sur les palmiers Elaeis du Congo belge. By L. Tihon. *Bull. Agric. Congo Belge* (1925, **16**, 371–386).

Le Traitement Mécanique des Fruits du Palmier à Huile. By M. A. Stieltjes. *Bull. Mat. Grasses, Marseille* (1925, Nos. 11–12, pp. 275–283.)

Le Commerce de l'Huile de Palme et des Palmistes en 1925. *Bull. Mat. Grasses, Marseille* (1926, No. 1, pp. 16–21).

Etude Chimique du Beurre de " Tama " (*Pentadesma butyracea*) de la Côte d'Ivoire. By F. Heim de Balsac, G. S. Dagand and R. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1926, **19**, 227–236).

Essential Oils.

Les Parfums en Guinée Française. By J. Goffart. *La Parfumerie Moderne* (1926, **19**, 33–36).

Guide to the Extraction of Eucalyptus Oil in the Field. By A. R. Penfold. *Bull. No.* 4 (Rev. ed.), *Technol. Museum, Sydney*. Pp. 30, $8\frac{1}{2} \times 5\frac{1}{2}$. (Sydney: Government Printer, 1925.) Price 6*d*.

Les Hespéridées. Articles on La Bergamote, by F. La Face; Les Dépilatoires; Terpeneless Essential Oils, by E. J. Parry; etc. *La Parfumerie Moderne* (1926, **19**, No. 3, pp. 41–68).

La Lavande Aspic et son avenir. By L. Lamothe. *La Parfumerie Moderne* (1926, **19**, 17–19).

Culture de la Menthe Franco-Mitcham. By J Ripert. *Notice No.* 22, *Office National des Matières Premières Végétales pour la Droguerie et la Parfumerie. Ministère du Commerce et de l'Industrie*. Pp. 32, $9\frac{1}{2} \times 6\frac{1}{4}$. (Paris, 1926) Price 10 frs.

Fibres.

Über die nutzbaren Pflanzenfasern Japans und ihre Verwertung. By K. Ohara. *Faserforschung* (1926, **5**, 157–162).

I tentativi di utilizzazione della *Calotropis procera* quale pianta tessile. By A Ferrara. *Agricolt. Col.* (1926, **20**, 81–99).

Die Aufbereitung der Flächse aus den Leinsortenversuchen der deutschen Landwirtschaftsgesellschaft im Jahre, 1924. By W. Müller. *Faserforschung* (1926, **5**, 162–179).

Einheitliche Flachsverarbeitung—das Mittel zum Aufstieg. Wirtschaftliche Forderungen eines Technikers. By N. Farmakowsky (*loc. cit.*, pp. 186–192).

Italian Hemp and the Factors in its Production and Cultivation. By Vincenzo, Melloni and Fo. *Cord Age* (1926, **8**, Feb., pp. 18, 35; March, p. 30).

The Production of Maguey Fiber in the Philippines. By H. T. Edwards. *Cord Age* (1926, **8**, May, pp. 26, 31).

Causes of Abaca Fiber Deterioration. By P. L. Sherman. *Cord Age* (1926, **8**, Feb., pp. 6, 34; March, pp. 18, 36; Apr., pp. 22, 24; May, p. 22).

Report on Silk Industry, Jamaica. By P. Hofman-Bang. *Journ. Jamaica Agric. Soc.* (1926, **30**, 123–125).

Etude sur les Lépidoptères producteurs de Soie de l'Afrique Occidentale Française. By P. de Fleury. *Bull. Comité d'Études Historiques et Scientifiques de l'Afr. Occ. Française* (1925, **8**, 544–558).

Cotton.

Report on the Possibilities of Cotton Cultivation in Ceylon. By G. R. Hilson. *Trop. Agric., Ceylon* (1926, **66**, 145–152).

A Survey of Factors affecting the Development of the Cotton Plant in the Oyo and Abeokuta Provinces of Southern Nigeria. By T. G. Mason and C. H. Wright. *4th Ann. Bull., Agric. Dept., Nigeria* (1925, pp. 3–31).

Report on the Improvement of Ishan Cotton (*Gossypium vitifolium*). By C. J. Lewin and T. G. Mason (*loc. cit.*, pp. 109–114).

American Cotton Trials in Kabba Province. By H. B. Waters. (*loc. cit.*, pp. 115–119).

Southern Rhodesia. Report on the Cotton Season, 1924–5. By G. S. Cameron. *Emp. Cotton Grow. Rev.* (1926, **3**, 147–164).

The Principles and Practice of Yield Trials. By F. L. Engledow and G. Udney Yule (*loc. cit.*, pp. 112–146).

An Investigation into the Relative Utility and the Reliability of various Methods of comparing the Yields of Cotton from Experimenta Plots. By R. Thomas and K. Sawhney. *Mem. No.* 11, *Dept. Agric., Iraq*. Pp. 48, 10 × 7½. (Baghdad : Government Press, 1925.)

Cotton Classing. By L. L. Gudge. *Queensland Agric. Journ.* (1926, **25**, 115–119).

The Future of Cotton Growing in Queensland. By G. Evans. *Emp. Cotton Grow. Rev.* (1926, **3**, 87–102).

Experimental Work on Cotton on certain Queensland State Farms during 1924–5. By G. Evans. *Queensland Agric. Journ.* (1926, **25**, 133–177).

Opportunité du développement de la production cotonnière. By M. Etesse. *Agron. Col.* (1926, **14**, No. 97, pp. 1–6 ; No. 98, pp. 74–85).

El Cultivo del Algodonero en la República Argentina. *Public. No.* 49, *Museo Agricola de la Sociedad Rural Argentina*. Pp. 24, 10½ × 7½. (Buenos Aires : Imprenta " Gadola," Rivadavia 775, 1926.)

Cearà Cotton and the Means adopted for its Improvement. By B. G. C. Bolland. *Int. Cotton Bull.* (1926, **4**, 236–243).

Preliminary Investigations of the Parasitism of certain Fungi causing Boll Rots of Cotton. By T. Laycock. *4th Ann. Bull., Agric. Dept., Nigeria* (1925, pp. 32–49).

A Disease of Queensland Cotton Seed (*Fusarium moniliforme*). By C. A. Pratt. *Emp. Cotton Grow. Rev.* (1926, **3**, 103–111).

Insect Pests of Cotton. By H. A. Ballou. *Proc. 9th W. Ind. Agric. Confer.* (1924, pp. 71–74).

Observations on the Extent of the Damage caused by Bollworms and Stainers to the Cotton Crop in Southern Nigeria. By A. W. J. Pomeroy and O. B. Lean. *4th Ann. Bull., Agric. Dept., Nigeria* (1925, pp. 50–63).

The Cotton Bollworms of Nigeria. By A. W. J. Pomeroy (*loc. cit.*, pp. 89–108).

A Statistical Survey of the Infestation of *Dysdercus* spp. on Cotton in Nigeria. By F. D. Golding (*loc. cit.*, pp. 64–81).

Observations on the Life History of *Helopeltis* on Cotton in Southern Nigeria. By O. B. Lean. *Bull. Entom. Res.* (1926, **16**, 319–324).

Observations on *Syagrus calcaratus*, F., and *Helopeltis bergrothi*, Reut., Minor Pests of Cotton in Southern Nigeria. By F. D. Golding. *4th Ann. Bull., Agric. Dept., Nigeria* (1925, pp. 82–88).

Life History of *Tectacoris lineola*, F., and its connection with Internal Boll Rots in Queensland. By E. Ballard and F. G. Holdaway. *Bull. Entom. Res.* (1926, **16**, 329–346).

Paper-making Materials.

Essais d'utilisation du " Luc-Binh " (*Eichhornia crassipes*, Water Hyacinth). *Agron. Col.* (1925, **13**, No. 96, pp. 249–251).

Essais de traitement du " Luc-Binh " à l'Ecole Française de Papeterie. By L. Vidal and M. Aribert (*loc. cit.*, pp. 252–266).

Valeur Papetière de deux Palmiers de Madagascar. "Satrabe" (*Medemia nobilis*, Hild. et W. Drude) and "Satramira" (*Hyphaene Schatan*, Boj.). By F. Heim de Balsac, J. Maheu, M. Cercelet, G. S. Dagand and R. Heim de Balsac. *Bull. Agr. Gén. des Col.* (1926, **19**, 23–58).

Rubber.

Para Rubber in Dominica. A Possible New Industry. By H. H. V. Whitchurch. *W. Ind. Comm. Circ.* (1926, **41**, 167).

Investigations on Native Rubber in connection with the Enquiry of the Native Rubber Investigation Committee. By W. Spoon. *Arch. Rubbercult.* (1926, **10**, 84–106).

Report on Longevity of *Hevea brasiliensis*. By F. G. Spring. *Malayan Agric. Journ.* (1926, **14**, 18–22).

Yields of Rubber from Bud-grafted Trees on Kajong Estate, Sungei Reko Division. By F. G Spring (*loc. cit.*, pp. 25–31).

Treatment of "Wet-Root Rot" in Malaya caused by *Fomes pseudo-ferreus*. By A. Sharples (*loc. cit.*, pp. 32–36).

Coagulation and Mould Prevention of Smoked Sheet Rubber. By H. P. Stevens. *Bull. Rubber Growers' Assoc.* (1926, **8**, 36–40).

The Specific Gravity of Hevea Latex. V—Some further Data on Latex with low Rubber Content and a Specific Gravity greater than that of Water. By O. de Vries. *Arch. Rubbercult.* (1926, **10**, 15–23).

Investigations in connection with the Flow of Latex. IV—Influence of Ringing on the Latex-yield. By W. H. Arisz (*loc. cit.*, pp. 141–148).

Some Experiments on the Preservation of Latex with Ammonia, Combined with Other Means. By O. de Vries. (*loc. cit.*, pp. 155–157).

The Acceleration of Vulcanisation by Alkaloids. By B. J. Eaton and R. O. Bishop. *Malayan Agric. Journ.* (1926, **14**, 8–12).

Variations in the Tensile Strength of Rubber-Sulphur Vulcanisates. By B. J. Eaton and R. O Bishop (*loc. cit.*, pp. 53-64).

Eenige Getah- en Rubbersoorten uit de Zuider- en Ooosterafdeeling van Borneo. By E. van der Laan and L. van Meurs. *Tectona* (1926, **19**, 1–26). [Summary in English, pp. 26–27.]

Eenige Mededeelingen Omtrent de in de Residentie Zuider- en Oosterafdeeling van Borneo voorkomende Katiausoorten. By C. N. J. Delmaar. (*loc. cit.*, pp. 142–149). [Summary in English, pp. 149–150.]

Tobacco.

Report on Tour through the Union of South Africa, Southern Rhodesia and Nyasaland Protectorate. [With special reference to tobacco.] By G. Corbett. Pp. 22, 10 × 6¼. (Port Louis, Mauritius: Government Printer, 1925.)

Tobacco Culture in Southern Rhodesia. The Harvesting and Curing of Virginia Tobacco. By D. D. Brown. *Rhodesia Agric. Journ.* (1926, **23**, 205–221).

Tobacco Mosaic in Southern Rhodesia. Selection for Resistance. By F. Eyles (*loc. cit.*, pp. 248–252).

The Tobacco Growing Industry in Southern Rhodesia. By E. M. Matthews (*loc. cit.*, pp. 253–256).

A Report on the Progress of White Burley Tobacco Cultivation in the Jaffna Peninsula, with Special Reference to the Seasons 1923–4 and 1924–5. By G. Harbord. *Year-book, Dept. Agric., Ceylon* (1926, pp. 24–26).

Report of the Officer in Charge, Tobacco Division, Department of Agriculture, Canada, for the year 1924. Pp. 32, 9¾ × 6½. (Ottawa: King's Printer, 1926.)

Culture et préparation du tabac en Océanie. By C. Henry. *Bull. de l'Ag. Gén. des Col.* (1925, **18**, 1374–1378).

Drugs.

Compte-rendu du cinquième Congrès National de la Culture des Plantes Médicinales (17–22 Juillet, 1925). By G. Blaque. Pp. 51, $9\frac{1}{2} \times 6\frac{1}{4}$. (Paris: Office National des Matières Premières végétales pour la Droguerie et la Parfumerie, 1926.) Price Frs. 10.

Note concernant les plantes medicinales ou officinales qui ont été introduites à Madagascar. By E. François. *Bull. Econ. Madagascar* (1925, pp. 123–127).

Das indische Opium. By O. Zekert. *Archiv der Pharmazie* (1926, Heft 3, pp. 237–248).

Studies on the Ash Constituents of Indian Opium. By H. E. Annett and M. N. Bose. *Investigations on Indian Opium No.* 6, *Mem. Dept. Agric., India* (1925, **8**, 45–51).

The Treatment of Leprosy by Vegetable Oils. By T. A. Henry. *Kew Bull.* (1926, No. 1, pp. 17–23).

Dyestuffs.

Notes on the Cultivation of Annatto. By B. Bunting. *Malayan Agric. Journ.* (1925, **8**, 336–338).

The Cultivation of Saffron and its Importance in Spain. By R. de Escauriaza. *Int. Rev., Sci. and Pract. of Agric.* (1926, **4**, N.S., 10–18).

Le Safran. By G. Pierlot. *Chim. et Indust.* (1925, **14**, 839–850).

Miscellaneous Agricultural Products.

The Institute of Brewing Research Scheme. Hop Investigations. Report on Manuring Experiments, 1924. By A. H. Burgess. *Journ. Inst. Brew.* (1925, **31**, 609–612).

The Institute of Brewing Reseaich Scheme. Report on the Fourth Season's Work at the Experimental Oast, 1924. By A. H. Burgess (*loc. cit.*, pp. 613–622).

The Institute of Brewing Research Scheme. The Influence of the Amount of Seed on the Value of Hops. By A. H. Burgess (*loc. cit.*, pp. 623–624).

Investigations on "Tuba." By B. A. R. Gater. *Malayan Agric. Journ.* (1925, **13**, 312–329).

Marketing of Derris (Tuba Root). By D. H. Grist. *Malayan Agric. Journ.* (1926, **14**, 79–80).

Quelques données utiles sur le *Phytelephas macrocarpa*, Ruiz. et Pav. By F. Claès. *Agron. Col.* (1925, **13**, No. 96, pp. 291–294).

Forestry.

General.

Annual Progress Report of the Administration in Ajmer-Merwara Forest, for the Year 1924–5. Pp. 39, $9\frac{1}{2} \times 6\frac{1}{4}$. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.2 (2*s*. 6*d*.).

Annual Report on Working Plans and Silviculture in Burma for the Year 1924–5. Pp. 65, $9\frac{3}{4} \times 7\frac{1}{2}$. (Rangoon: Superintendent, Government Printing, 1926.) Price Rs. 2 (3*s*.).

Reports on certain Forest Areas of Tavoy and Mergui Districts inspected from the Ground as a Preliminary to the Aerial Stockmapping of these Districts, 1924–5. By C. W. Scott and C. R. Robbins. *Burma For. Bull. No.* 14 (*Silvicult. Ser. No.* 10). Pp. 42, $9\frac{3}{4} \times 6\frac{1}{4}$. (Rangoon: Superintendent, Government Printing, 1925.)

Annual Report on Sylviculture and Forest Research in the Central Provinces, 1923–4. Pp. 24, 9½ × 7¼. (Nagpur: Superintendent, Government Printing, 1925.)

Despatch from the Secretary of State for the Colonies, dated 22nd December 1925, relating to the Report on Forestry in Trinidad and Tobago by the Conservator of Forests. *Council Paper No.* 8 *of* 1926, *Trinidad and Tobago.* Pp. 6, 13 × 8½. (Trinidad: Government Printer, 1926.) Price 3*d*.

Report of the Forestry Commission, New South Wales, for the period ended 30th June 1925. Pp. 17, 13 × 8½. (Sydney: Government Printer, 1926.)

Sixth Annual Report, Forests Commission of Victoria, 1924–25. Pp. 12, 13 × 8½. (Melbourne: Government Printer, 1925.) Price 9*d*.

Statistical Methods in Forest Investigative Work. *Bull. No.* 77, *For. Br., Dept. Inter., Canada.* Pp. 36, 9¾ × 6½. (Ottawa: King's Printer, 1925.) Price 25 cents.

Logging and Marketing Problems with Tropical Timbers. By D. M. Matthews. *Bull. Pan Amer. Union* (Dec. 1925, pp. 1225–1230).

Best Time for Sowing Silver Fir in the Nursery. By J. V. Hofmann. *Journ. Agric. Res.* (1925, **31**, 261–266)

Timbers.

Report No. 15, Timber Committee, South African Railways and Harbours, for 1925. Pp. 11, 13 × 8 (mimeographed) [Includes particulars of service tests, mechanical tests, plantations, uses of South African timbers, seasoning experiments, preservative treatment, etc.]

Les bois coloniaux d'Afrique dans l'industrie. By J. Meniaud and F. Bretonnet. *Bull. Ag. Gén. des Col.* (1926, **19**, 163–188).

Second Interim Report on the Work under Project No. 1 by the Section of Timber Testing, including the results of the Mechanical and Physical Tests on certain of the commoner Indian Timbers up to the end of 1924. By L. N. Seaman and C. R. Ranganathan. *Ind. For. Rec., Econ. Ser.* (1925, **12**, 107–123).

The Kiln Drying of Timber. A Series of Ten Lectures by H. D. Tiemann. Pp. 63, 11 × 8½. (Melbourne: Government Printer.)

Observations on the Attacks of Boring Beetles on some Australian Timbers. By the Technological Museum, Melbourne. *Austral. For. Jour.* (1925, **8**, 319–322).

Preventing Damage by Lyctus Powder-Post Beetles. By T. E. Snyder. *Farmers' Bull. No.* 1477, *U.S. Dept. Agric.* Pp. 12 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Tanning Materials.

The Principal Tanning Materials of Australia and their Leather-Forming Properties. By M. B. Welch and F. A. Coombs. *Bull. No.* 10, *Technol. Mus., Sydney.* Pp. 20, 8½ × 5½. (Sydney: Government Printer, 1926.) Price 6*d*.

Gambier (*Gambier uncaria*). Its Extraction and Valuation. By B. J. Eaton and R. O. Bishop. *Malayan Agric. Journ.* (1926, **14**, 37–43).

The Production and Marketing of Gambier. By D. H. Grist (*loc. cit.*, pp. 44–48).

Valeur, comme matière tannant, de deux écorces de Lauracées d'Indochine. By F. Heim de Balsac, A. Deforge and J. Maheu. *Bull. Ag. Gén. des Col.* (1926, **19**, 214–226).

NOTICES OF RECENT LITERATURE.

INDIA. By Sir Valentine Chirol. *The Modern World: A Survey of Historical Forces. Volume V.* Pp. 352, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: Ernest Benn, Limited, 1926.) Price 15*s*.

The present volume is the fifth to appear in Messrs. Benn's series *The Modern World* and is undoubtedly among the most important. Sir Valentine Chirol's high standing as an authority on Indian affairs gives special weight to this treatise, in which he surveys the chief political and social movements which have characterised India in recent times and discusses their bearing on the welfare of the country and of the British Empire as a whole. All students of current Indian politics should read the book.

WESTERN AUSTRALIA: AN OFFICIAL HANDBOOK FOR THE INFORMATION OF COMMERCIAL MEN, MIGRANTS, AND TOURISTS. Compiled under the authority of the Government of Western Australia. Pp. 264, $9\frac{3}{4} \times 7\frac{1}{2}$. (Perth: Government Printer, 1925.)

An admirable production, full of useful information on the immense territory administered by the Government at Perth, and of great utility to intending emigrants and all others interested in the development or commerce of the State. The subject-matter is well arranged, and the volume contains a large number of photographic illustrations as well as several maps, diagrams and coloured plates.

THE SOUTH AND EAST AFRICAN YEAR BOOK AND GUIDE. Edited annually by A. Samler Brown, F.R.M.S., and G. Gordon Brown, F.R.G.S., for the Union-Castle Mail Steamship Company, Limited. 1926 Edition. Pp. li + 923, $7\frac{1}{2} \times 5$, with Atlas and Diagrams. (London: Sampson Low, Marston and Co., Ltd., 1926.) Price 5*s*.

This is the thirty-second issue of a very practical, well-written and comprehensive work of reference, full of admirably arranged information on the countries with which it deals. As is to be expected the Union of South Africa occupies a specially prominent place, but other countries (including the Island of Mauritius) are well described. The book furnishes a mass of useful details, of interest to travellers (on business or pleasure) and to all concerned with the trade and development of the vast region in question.

KAFFEE. By Prof. Dr. Albrecht Zimmermann. Bangerts Auslandbücherei, Bd. 27. Reihe: Wohltmann-Bücher Monographien zur Landwirtschaft warmer Länder, Band 4. Pp. vii + 204, $7\frac{1}{4} \times 5$. (Hamburg: Deutscher Auslandverlag Walter Bangert, 1926.) Price RM.5.

The author of this useful monograph has resided in the tropics for twenty-three years, during which he has had

considerable experience of coffee growing, and is therefore well qualified to deal with the subject. The book has been written very concisely but nevertheless the whole subject is well covered. After describing the botanical characters of the different varieties and hybrids of coffee which are grown for the world's markets, the work gives an account of the biology of the coffee tree, the methods of planting and cultivating coffee estates, the diseases and pests by which the tree is liable to be attacked, the harvesting of the crop and its preparation for the market, the composition of the berries, the grading of the product, and the market prices obtainable. A short list of the more important publications dealing with coffee is appended.

East African Pasture Plants. I. East African Grasses. Pp. 56, $9\frac{1}{2} \times 6$. (London: The Crown Agents for the Colonies, 1926.) Price 2s. 6*d*.

This useful publication is the outcome of a suggestion made by Dr. E. Montgomery, Veterinary Adviser to the Governments of Kenya, Uganda and Tanganyika Territory, and has been prepared at Kew for the Governments mentioned. It comprises descriptions in relatively non-technical language of twenty common grasses occurring in the pasture lands of East Africa, and each grass is illustrated by an excellent drawing which includes botanical details. There is little doubt that the object of the book, which is to enable common pasture grasses to be identified by those without botanical knowledge, will be fully realised and a very useful purpose thereby served.

In each case the botanical and vernacular names of the grasses are given and a careful description follows. Notes are given regarding the geographical distribution of the species and their suitability for fodder purposes. Among useful species mentioned are *Hemarthria fasciculata* ("swamp couch"), a swamp grass much valued in Rhodesia; *Themeda triandra* ("ngugi," etc.), one of the commonest grasses of the dry regions of Africa; *Brachiaria brizantha* ("kimbua"); *Echinochloa colona* ("odago"), the grain of which adds considerably to its fodder value; *Panicum maximum* ("e'rube," "guinea grass"), one of the best fodder grasses of the tropics; *Cynodon Dactylon* ("Uganda grass," "Bermuda grass"), well known for its feeding value and as a turf grass; *Chloris virgata* var. *elegans*, largely used in the Transvaal for hay; and *Pennisetum clandestinum*, the valuable "Kikuyu grass." Descriptions are also given of a number of grasses of little or no value for fodder, e.g., *Imperata cylindrica* var. *Thunbergii* and *Cymbopogon excavatus*.

A useful introduction to the book gives a description of a typical grass plant and a simple account of the general principles on which the classification of grasses is based.

An Elementary Manual on Indian Wood Technology. By H. P. Brown, Ph.D. Pp. xiii + 121, with 16 plates, 10 × 7¼. (Calcutta: Government of India Central Publication Branch, 1925.) Price Rs.4, or 6*s*. 9*d*.

This manual was written by the author to supply a need felt by him when giving courses of instruction in wood anatomy to classes of Indian Provincial students attending the Forest College at Dehra Dun. Like other teachers of natural science in countries overseas he found it necessary to rely upon descriptions of extra-tropical "types," since published information regarding the anatomy of Indian timbers was very meagre. He has therefore produced a book which is essentially an elementary treatise on wood anatomy as exemplified by selected Indian timbers, supplemented by a "key" for the identification of a number of well-known species. The author deals with the gross structural features of wood which are discernible with the naked eye or under a low magnification, and then discusses the physical properties of wood of value in identification. The third section, which is devoted to the microscopical characters of timber, provides most interesting reading; special attention is given to the anatomy of chir pine (*Pinus longifolia*) as an example of Indian coniferous woods, while teak is described in illustration of the timber of dicotyledons. The text concludes with a "key" to the identification of sixty of the most important timbers of India, based upon characters visible to the eye or under low magnification.

The first forty pages of the book are concerned with a useful account of the fundamentals of the subject and deal with the divisions of the plant kingdom, the structure of the cell and the origin and classification of plant tissues. In his preface the author expresses a fear that he may be criticised for devoting so large a proportion of the book to these questions. Taking into account the class of student for which the book is intended it would seem that his decision to write this section is fully justified and renders the volume a self-contained text-book which should be a great convenience to the students concerned. A large number of excellent photo-micrographs by the author, and other illustrations by Babu Ganga Singh, add much to the practical value of the book. A useful glossary is provided.

Forest Management. By A. B. Recknagel, B.A., M.F., John Bentley, Jr., B.S., M.F., and C. H. Guise, B.S., M.F. Second edition, thoroughly revised. Pp. xvii + 329, 9¼ × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 17*s*. 6*d*.

The first edition of this book was reviewed in this Bulletin (1920, **18**, 146). In general plan the revised edition is essentially the same, comprising sections dealing with the main principles

of Forest Mensuration, Forest Organisation and Forest Finance; the subject of Forest Administration has now been omitted on the grounds that it is of no special importance to those for whom the book is primarily intended. The principal additions to the part dealing with forest mensuration comprise an article on aerial timber surveys and a chapter on planting surveys. The section concerned with forest organisation has been entirely recast and is written in accordance with modern American practice. Similarly, the part dealing with forest finance has been re-written and much extended, and special attention has been paid to accounts of the "determination of stumpage values," "forest taxation" and "standing timber insurance."

THE INSECT AND RELATED PESTS OF EGYPT. By F. C. Willcocks. Vol. II. Insects and Mites feeding on Gramineous Crops and Products in the Field, Granary and Mill. Pp. viii + 418, $12\frac{1}{2} \times 9\frac{1}{2}$. (Cairo: Sultanic Agricultural Society, 1925.)

The first volume of this work comprised a detailed study of the pink boll-worm affecting cotton. The second volume now under notice is by the same author and gives the results of a corresponding enquiry into the habits of the insects feeding on the gramineous food-crops of Egypt, the nature and importance of the damage caused by them, and, so far as possible, methods of combating the pests. The subject is admittedly a vast one, but the present volume with its excellent coloured plates and other illustrations is a valuable contribution to a knowledge of these important creatures. The book includes five sections dealing respectively with the insects feeding on wheat and barley, maize, millets, sugar cane, and rice, while a further section is concerned with insect pests occurring in granaries and mills. It is interesting and satisfactory to note that although maize, wheat and barley are extensively grown in Egypt, there is no species of insect feeding on these crops that can be said to rank as a real pest, though a large number are of minor importance and have received careful study by the author. Sugar cane also is fairly free from insect pests with the exception of the mealy bug (*Pseudococcus sacchari*) and certain "borers." In the case of rice comparatively little investigation has been made regarding the degree of damage caused by pests. The same may be said of millet (*Sorghum vulgare*) and in this case the author is inclined to believe that the crop may suffer more from insect attack than is commonly supposed. The grain crops of Egypt therefore enjoy at present a comparative freedom from insect pests, but the well-known insects and mites infesting granaries and mills throughout the world cause considerable damage in Egypt. The author in giving an account of these pests has drawn upon his previous notes on the subject published in the *Yearbook of the Khedivial Agricultural Society.*

A REPORT ON THE SUGAR CANE MOSAIC SITUATION IN FEBRUARY, 1924, AT SOLEDAD, CUBA. By Edward M. East and William H. Weston, Jr. Pp. 52, $10\frac{3}{4} \times 7\frac{3}{4}$, with 9 plates. (Cambridge, U S.A.: Harvard University Press; London: Humphrey Milford, 1925.) Price 8*s.* 6*d.*

This report is the first of the "Studies from the Harvard Institute of Tropical Biology and Medicine," and gives an account of the position of sugar cane mosaic disease as it existed on the Soledad sugar estate situated near Cienfuegos, Cuba, in 1924. The mosaic occurring at Soledad was recognised as the same infectious disease as has been recorded under that name from all the chief cane growing countries, and it was therefore considered that the publication of the report (originally intended for the owner of Soledad) would be of interest to sugar planters generally.

Infection was found at Soledad in cane of all ages, growing on every type of soil. The most important source of infection is diseased cane and there is abundant evidence that diseased cuttings give rise to mosaic shoots. Observations showed, however, that many, sometimes a majority, of the shoots from an infected plant may throw off all symptoms of disease. There is no evidence at Soledad that mosaic disease is reducing either the tonnage of cane per acre, the yield of juice, the sugar content, or the purity of the sugar; but it is not contended that disease occurring at an early age and long continued is without adverse effect on the cane. In the opinion of the authors, sugar cane is relatively resistant to mosaic disease in comparison with certain other plants, such as tobacco. The varieties of cane at Soledad exhibit hereditary differences in this respect; "Crystalina" is resistant, but no variety is immune and none is exceptionally susceptible. While not regarding the threat of mosaic as serious in Cuba, the authors recommend that only "seed" apparently free from disease should be used for propagation, and they suggest methods of raising such seed. They also recommend that the edges of fields and roads should be kept free from weeds and wild grasses which may harbour the disease.

LIME IN AGRICULTURE. I. In Plant Nutrition. 2. In Animal Nutrition. A Handbook for Practical Farmers, Students, and others. By Frank Ewart Corrie, B.Sc., N.D.A., N.D.D. Pp. ix + 100, $7\frac{1}{4} \times 5$. (London: Chapman and Hall, Ltd., 1926.) Price 3*s.* 6*d.*

In this little book an account is given of the importance of lime both to plants and animals. In the first section, the chemistry and sources of lime are considered and attention is directed to the functions of lime in soils and its indispensability

for crops. The methods of applying lime to the soil are explained and its effects illustrated by reference to various experiments. In the second section, the author deals with the lime requirements of animals and the effects of a deficiency of this constituent in their rations. The principal sources of lime to the animal are enumerated, and it is shown that deficiency of lime in the soil is reflected in the lime-content of the plants grown on it and thus adversely affects the value of fodder crops to stock.

The author states that the need for lime is so great that, in his opinion, " the reasonable provision of lime to the farmer should be one of the first considerations of those concerned with agriculture in this country, and all other efforts to help agricultural progression are mitigated and often damned by the failure to recognise the importance of lime."

MARKETING OF AGRICULTURAL PRODUCTS. By James E. Boyle, Ph.D. Pp. viii + 479, 9¼ × 6¼. (London: McGraw-Hill Publishing Co., Ltd., 1925.) Price 17*s.* 6*d.*

This book, by the Professor of Rural Economy at the College of Agriculture, Cornell University, deals for the greater part with the numerous economic and other factors concerned in the marketing of agricultural products in such a way as to yield the maximum profit to industrial enterprise. The book is divided into two parts, the first of which deals with the fundamental principles of marketing, with reference to the interests of the consumer, the producer and the middleman, whilst the second part is concerned with the application of these principles and discusses the problems of improved production, cheaper distribution, and better prices, and the means of solving them by individual, co-operative, and governmental efforts. Each chapter is followed by a set of examination questions.

The way in which the subject-matter is presented is such as to appeal to American academic habits of thought rather than those of the average British agriculturist, but the book will be found to offer many suggestions of interest to producers and distributors both in the United Kingdom and in other parts of the Empire.

HEREDITY. By A. Franklin Shull, Professor of Zoology in the University of Michigan. Pp. xi + 287, 9½ × 6. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 15*s.*

Considerably more than one-half of this volume, which has been written for students who have had " no previous training in biology," is concerned with an introduction to the study of heredity from a general standpoint. The author after a brief

historical survey, explains clearly and fully, with the aid of a number of excellent figures and diagrams, the principles of Mendelian inheritance, concluding the earlier part of the book with interesting chapters on non-Mendelian inheritance, variable characters, and heredity and evolution. He then proceeds to deal with heredity in connection with the human race and human affairs. After a discussion of the inheritance of structural, physiological and mental characters in man, a chapter is devoted to an explanation of the applications of heredity to domestic animals and plants. A description of the eugenics movement is followed by a chapter on population, perhaps the most valuable in this part of the book; the impending "saturation" of many countries is emphasised and reduction of the birth-rate is deemed imperative. The work concludes with chapters on race problems and immigration.

An Introduction to Industrial Chemistry. By S. I. Levy, M.A., Ph.D., F.I.C., with an introduction by Sir William J. Pope, K.B.E., D.Sc., LL.D., F.R.S. Pp. xiii + 288, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: G. Bell & Sons, Ltd., 1926.) Price 15*s*.

This volume is a general introduction to the whole subject of industrial chemistry and deals with the principles underlying all chemical industries. Detailed information is supplied regarding a few of the more important industries, but rather as illustrating the general principles than with a view to complete treatment.

After a chapter on process costing and process costs, the author gives an excellent description of the various types of apparatus used in large-scale operations, such as heating and cooling, grinding, mixing, filtering and washing, extracting, distillation, evaporation, drying, and sublimation, and also of plant necessary for the transport and manipulation of materials, their storage and measurement, and the provision of power. This is followed by a general survey of the chemical industries with special chapters on the manufacture of sulphuric acid, on the alkali industry, and on intermediates and explosives. The book contains a number of excellent illustrations and diagrams and will be of value as a text-book both to the young industrial chemist at the commencement of his career and also to instructors in applied chemistry.

Specification. Edited by Frederick Chatterton, F.R.I.B.A. Pp. viii + 663, $12\frac{3}{4} \times 8\frac{3}{4}$. (London: The Architectural Press, 1926.) Price 10*s*. 6*d*.

This annual publication deals comprehensively with subjects of interest to architects, surveyors, civil engineers, and builders, and in particular with such matters as are more

directly connected with the drawing up and carrying out of specifications in the building trade. It consists mainly of sections devoted to different trades or crafts, each containing information regarding the materials and practice of such craft, followed, in most cases, by specification clauses for the materials and workmanship used in its exercise. The subjects dealt with cover a wide field, from the arts of the bricklayer, mason, carpenter and plumber to the uses of concrete and the problems of heating, illumination, ventilation, and sewage disposal. One chapter contains useful information on miscellaneous topics, such as the construction of strong-rooms, refrigeration and cold storage, vacuum cleaning plant, etc.

At the beginning of the volume there are a few special articles, including one on "Empire Timbers" in which an account is given of the work of the Imperial Institute Advisory Committee on Timbers.

There is a very full index to the subject matter contained in the volume, as well as alphabetical and classified indexes to the numerous advertisers whose announcements appear throughout its pages.

Directory of Paper Makers of the United Kingdom for 1926. Pp. 272, $10\frac{1}{4} \times 7\frac{1}{4}$. (London: Marchant Singer & Co., 1926.) Price 5*s.*

In this edition, which represents the 50th annual issue of this useful Directory, the classified lists of paper-makers, paper enamellers, wholesale stationers, and paper mills, and the other useful information supplied, follow the same arrangement as in previous editions, but the whole of the matter has been carefully revised and brought up to date.

The Chemical Engineering and Chemical Catalogue. Second Edition. Compiled with the co-operation of leading British manufacturers by Leonard Hill. Edited by D. M. Newitt, Ph.D., B.Sc., D.I.C., A.R.C.S., A.I.C., A.I.Chem.E. Pp. vii + 360, $10 \times 7\frac{1}{2}$. (London: Leonard Hill, 173, Fleet Street, London, E.C.4, 1926.) Price 20*s.* (15*s.* to annual subscribers).

This annual compilation, of which the present edition is the second issue, should be a useful book of reference for all who have to do with chemical manufacturing technology, either as works managers or as consulting chemists or engineers.

A part of the volume consists of an index of chemicals and plant, with a list of firms, mostly manufacturers, under each heading. In another section nearly 150 firms describe their

wares, in most cases with the aid of illustrations. These firms are referred to as "space users," not as "advertisers," the object of the compilers being to set out concise particulars as to the uses of materials and plant, with such data as tables of sizes and capacities, and to exclude displayed advertising or comparative claims of excellence.

The book also contains a number of miscellaneous chemical and engineering tables and data, as well as specifications, approved by the British Engineering Standards Association, for cast-iron and enamelled cast-iron steam-jacketed pans and for cast-iron filter presses.

THE ENGINEER AND THE PREVENTION OF MALARIA. By Henry Home, M.Inst.C.E. Pp. x + 176, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: Chapman & Hall, Ltd., 1926.) Price 13*s.* 6*d.*

This book is an attempt to give the engineer working in the tropics a résumé of the results obtained during the past fifteen years in the scientific investigations and efforts that have been made in connection with the destruction of the species of mosquitoes responsible for the transmission of the malarial parasite. Furnished with such a knowledge of the principles underlying the modern application of anti-malarial measures, the engineer is in a better position to carry out his work in this direction.

The first section of the book is occupied with the question of the initiation of an anti-malarial campaign and the identification of the malarial vector, and stresses the importance of specific sanitation against proved malarial vectors rather than general sanitation against all mosquitoes on account of the high cost of labour and materials and the frequent scarcity of the former. Then follow chapters dealing with the drainage and malarial conditions in lowland country, in townships and in hill country, with notes on the points that will arise in connection with anopheline breeding places. Practical details are given on works construction and the value of anti-malarial services, e.g. the use of oil and larvicides, the value of larvae-eating fish, etc. Houses in the tropics are dealt with in a separate chapter, while the concluding one discusses the biological means of attack against the anopheline species of mosquito, as by this means a decisive and radical method of dealing with the malarial problem may be found.

The first of the four appendixes to the book is a reprint of a communication on mosquito netting, made by Brevet Lieut.-Col. W. P. MacArthur, D.S.O., M.D., to the Journal of the Royal Army Medical Corps, and the next two are papers on applied entomology and house flies by P. A. Buxton, M.R.C.S., L.R.C.P. The final appendix is a chapter on water and contains an abstract of a paper by T. Tusting Cocking,

F.I.C., on PH values, which is of importance in view of the fact that the hydrogen ion concentration in water appears to be a factor limiting the range of certain species of anopheles.

The book is illustrated with a number of plates and text figures.

THE ACQUISITION AND GOVERNMENT OF BACKWARD TERRITORY IN INTERNATIONAL LAW. By M F. Lindley, LL.D., B.Sc. Pp. xx + 391, 9 × 6. (London: Longmans, Green & Co., Ltd., 1926.) Price 21*s*.

The term "backward" in connection with human communities is relative and necessarily ill-defined; the scope of this book is therefore perhaps better indicated by its sub-title "A Treatise on the Law and Practice relating to Colonial Expansion."

The first two parts deal with territories that are open to acquisition, and with questions as to who may acquire territorial sovereignty, the latter including considerations as to the legal position of individuals, chartered companies and other corporations, states, colonies and parts of a state, and pluralities or leagues of states, in regard to the exercise of sovereignty over acquired territory.

The third part is concerned with the methods that have been, or are, employed for the acquisition of territory, including papal grants, discovery, effective occupation, conquest, cession and prescription, and reviews historically the recognition, among the nations of Europe, of titles to territories acquired by these means. It also treats of protectorates, spheres of influence, leases, and the mandatory system of the League of Nations.

The fourth section relates to the exercise of acquired sovereignty. It deals with such matters as the position of foreigners in annexed territories and protectorates, the duties of a sovereign state in regard to natives, native property and institutions, slavery and compulsory labour, and the trades in liquor and arms.

The book is clearly and interestingly written. There are a number of references to international arbitrations and awards and to British and United States law cases, and for those who wish to make a more exhaustive study of the subject there is an excellent bibliography of works referred to in the text.

BOOKS RECEIVED.

STATISTICAL ATLAS OF THE BOMBAY PRESIDENCY. Third Edition. Prepared and revised by the Director of Agriculture. 194 pp. of text and numerous maps and charts, 17×14. (Bombay: Government Central Press, 1925.) Price *Rs.*30 or £2 6*s*. 5*d*.

CO-OPERATION AND COMPETITION IN THE MARKETING OF MAIZE IN SOUTH AFRICA. By Herbert Frankel, M.A. Pp. xi + 144, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: P. S. King & Son, Ltd., 1926.) Price 8*s*. 6*d*.

THE CLOVE OF COMMERCE (ZANZIBAR AND PEMBA) INCLUDING COST AND CHARGES CALCULATOR. By W. Grazebrook. Pp. 81, $9\frac{3}{4} \times 6\frac{1}{4}$. (London: The Commercial Calculating Co., Ltd.; East Africa: Grazebrook, Bartlett & Co., P.O. Box 26, Tippu Tib House, Zanzibar, 1925.) Price 15*s*., or *Rs*.10, or $3·60.

THE KILN DRYING OF LUMBER. By Arthur Koehler, B.S., and Rolf Thelen, B.S. Pp. x + 293, $9\frac{1}{4} \times 6$. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 15*s*.

OXFORD FORESTRY MEMOIRS, NUMBER 4, 1926. MEASUREMENTS OF THE CUBICAL CONTENTS OF FOREST CROPS. By M. D. Chaturvedi, B.Sc. Pp. xv. + 142, $10\frac{3}{4} \times 7\frac{1}{2}$. (London: Humphrey Milford, Oxford University Press, 1926.) Price: Paper 10*s*., Cloth 12*s*. 6*d*.

OXFORD FORESTRY MEMOIRS, NUMBER 5, 1926. THE PHYSIOGRAPHY OF SOUTHERN NIGERIA AND ITS EFFECT ON THE FOREST FLORA OF THE COUNTRY. By J. R. Ainslie, B.Sc. Pp. 36, $10\frac{3}{4} \times 7\frac{1}{2}$. (London: Humphrey Milford, Oxford University Press, 1926.) Price 4*s*.

THE INTERNATIONAL REVIEW OF MISSIONS. Vol. XV, No. 79, July, 1926, Special Double Africa Number. Pp. 101. [Issued as a preliminary to an international conference on the Christian Missions in Africa, called by the International Missionary Council to meet in Belgium, September, 1926. The contents range from discussion of administrative or social problems and racial inter-relations to incidents of current missionary work.]

CONTENTS

VOL. XXIV. NO. 2

PART B—MINERAL RESOURCES

PART B.—MINERAL RESOURCES.

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE.

Selected from the Reports made to the Dominion, Colonial and Indian Governments.

CEMENT MATERIALS FROM NYASALAND.

In a previous issue of this Bulletin (1924, **22**, 445), a résumé of a number of the investigations which had been carried out at the Imperial Institute on cement-making materials from Nyasaland was given in an article on "Cement Manufacture in the Crown Colonies." The present article deals with certain investigations which have been made since the above article appeared.

All the materials dealt with in the present article were forwarded to the Imperial Institute by F. Dixey, Government Geologist of Nyasaland and Corresponding Member of the Imperial Institute, who has devoted special attention to the possibilities of cement manufacture in that Protectorate.

While on leave in Great Britain during the early part of 1926, the Government Geologist kindly supplied the Imperial Institute with details of the mode of occurrence and extent of the several deposits of cement materials dealt with in this article, together with notes on the local fuel resources and means of transport. This useful information will be found, in tabular form, following the results of the investigations carried out at the Imperial Institute (see p. 316).

MOUNT WALLER DISTRICT.

Late in 1924, samples of clay and limestone collected in the Mount Waller area, North Nyasa, were sent by the Government Geologist to the Imperial Institute in order that their suitability for use in cement making might be ascertained. The samples received were as follows:—

"*Clay No.* 1.—Superficial clay from roadside opposite the Livingstonia Mission Garden, Vúngu Vungu Valley."

A reddish-brown ferruginous clay containing a large amount of quartz sand and occasional small stones .

"*Clay No.* 2.—Karroo clay from Cross Roads, Manchewe Valley."

A yellowish mottled clay, containing some iron oxide concretions; very little coarse quartz was present, most of the free silica occurring in a finely divided form.

"*Clay No.* 3.—Karroo clay from white clay pit, Livingstonia Mission Brickfield."

A greyish clay streaked with stains of iron oxide. The quantity of coarse quartz present was small, most of the free silica being present in a finely divided form.

"*Limestone.*—Karroo limestone from Twijitwalima Stream, Rumpi Gorge."

The material consisted of (No. 4) a compact, hard, highly siliceous limestone, of purple colour, the silica appearing to be present chiefly as a cementing agent and not in granular form, and (No. 5) concretionary nodules, of similar colour to the compact variety, but containing bands of calcite.

Limestone No. 6.—During 1926, a further sample of nodular limestone which had been taken from Chiweta village, at the mouth of the Rumpi River in the Mount Waller area, was received for examination.

This material was of similar appearance to sample No. 5 above, but the bands of calcite were more in evidence.

The three clays were analysed with the following results :—

		No 1 *Per cent.*	No. 2. *Per cent.*	No. 3. *Per cent.*
Free silica	SiO_2	47·28	30·70	50·44
Combined silica	SiO_2	13·12	24·80	18·20
Alumina	Al_2O_3	17·12	22·21	19·36
Ferric oxide	Fe_2O_3	9·21	6·91	1·78
Titanium dioxide	TiO_2	1·13	0·60	0·76
Lime	CaO	0·38	0·28	0·20
Magnesia	MgO	0·46	0·80	0·49
Potash	K_2O	1·28	1·34	0·80
Soda	Na_2O	0·14	nil.	0·10
Sulphuric anhydride	SO_3	0·14	0·11	0·09
Loss on ignition	$\left\{\begin{matrix} H_2O \\ CO_2 \end{matrix}\right\}$	9·72	12·66	8·26
Sand coarser than 100-mesh		23·6	6·6	0·5

The amount of coarse sand in Clay No. 1 is considerably greater than is permissible in material intended for use in the manufacture of Portland cement, but Clay No. 2 could be used for this purpose in conjunction with a limestone of good quality.

The percentage of silica in clay No. 3 is rather too high in relation to that of the alumina and iron ; but the composition could be adjusted satisfactorily by mixing a small quantity of finely ground iron ore with the clay.

Chemical analyses of the three limestones gave the following results :—

		No. 4. Compact limestone. *Per cent.*	No. 5 Nodular limestone. *Per cent.*	No. 6 Nodular limestone *Per cent.*
Free silica	SiO_2	42·20	14·92	8·74
Combined silica	SiO_2	0·14	0·63	
Alumina	Al_2O_3	8·01	3·15	2·50
Ferric oxide	Fe_2O_3	3·07	0·47	0 92
Manganous oxide . .	MnO	1·48	0·53	*
Lime	CaO	21·20	41·88	46·61
Magnesia	MgO	1·14	1·08	1·57
Sulphuric anhydride . .	SO_3	0·25	0·15	*
Loss on ignition . .	$\left\{\begin{matrix} H_2O \\ CO_2 \end{matrix}\right\}$	19·18	34·36	37·49

* Not determined

Owing to the large amount of silica and the relatively low percentage of lime present in the compact limestone (No. 4), the material would not be suitable for making Portland cement or hydraulic lime. Nodular limestone No. 5 also contains too large a percentage of silica to permit of its use in the manufacture of Portland cement.

The second sample of nodular limestone (No. 6) contains a smaller amount of silica than was found in the material previously received, while the quantity of lime present is higher. Material represented by this and the preceding sample could be used in conjunction with a suitable clay for the manufacture of Portland cement which would conform to the requirements of the British Standard Specification, but owing to the irregular distribution of the calcite, it is possible that difficulty would be encountered in maintaining a constant composition of the raw mixture.

If, however, such difficulty could be overcome, a Portland cement conforming to the requirements of the British Standard Specification could be made from a mixture of about 7·5 parts of the nodular limestone No. 5 with one part of clay No. 2 (see p. 304) which also occurs in the Mount Waller area about three miles from the limestone deposit. It is of interest to note that this is one of the few districts in Nyasaland where suitable limestone, clay and coal occur in fairly close proximity to one another and to transport facilities.

As it seemed possible that the nodular limestone represented by sample No. 5 might be utilised for the production of other cements, technical trials were made at the Imperial Institute in order to determine whether it could be used for making (a) hydraulic lime, (b) grappier cement, and (c) natural cement.

Hydraulic Lime.

The limestone was broken into pieces small enough to pass a $1\frac{1}{2}$-inch ring and preliminary burning trials were made. It was found that the best results were obtained when the material was burnt for four hours at a temperature of 950° to 1000° C.

The product obtained by burning the limestone was hand-picked, a few fused portions being rejected, as these were found to be devoid of hydraulic properties. The remaining lumps were sprinkled with water and left to slake for 24 hours, after which they were screened on a sieve having 50 holes per linear inch to remove the unslaked lumps (" grappiers "). The " grappiers," which amounted to 40 per cent. by weight of the lump lime, were ground and their properties tested separately (see p. 308).

In the following table are shown the results of the chemical analysis of the lime produced from the first sample of nodular (No. 5) limestone (after separation of the " grappiers ") and a typical sample of good quality commercial grey stone (hydraulic) lime. The analyses are calculated on a loss-free basis.

		Hydraulic lime from limestone No. 5.	Freshly burnt commercial grey stone lime.
		Per cent.	*Per cent.*
Lime	CaO	78·65	84·70
Magnesia	MgO	1·81	0·79
Ferric oxide	Fe_2O_3	0·35	1·25
Alumina	Al_2O_3	2·56	4·04
Manganous oxide	MnO	(†)	(†)
Sulphuric anhydride	SO_3	0·26	(†)
Silica (free)	SiO_2	2·52	nil.
Silica (combined)	SiO_2	12·13	8·92

† Not determined.

The tensile strength of the mortar produced with the slaked hydraulic lime obtained as described above was tested by mixing it with standard sand in the proportions of (1) 4·35 parts of sand to one part of slaked lime and (2) 8·7 parts of sand to

one part of slaked lime by weight. These proportions correspond to 5 to 1 and 10 to 1 by weight respectively, calculated on the caustic or unslaked lime. Tensile strength tests under similar conditions were also made, for comparative purposes, with a sample of freshly burnt commercial grey stone lime, the analysis of which is given above.

The sand used in these tests was that specified for use in connection with the British Standard Specification for Portland Cement (1925).

The briquettes made for testing the tensile strength of the hydraulic lime mortar were compacted into the moulds by thumb pressure only, and after remaining for seven days in an atmosphere saturated with moisture, the briquettes were removed from the moulds and further treated as follows :—

Series (a).—The storage in an atmosphere saturated with moisture was continued for further periods of 21 days, 49 days and 84 days respectively.

Series (b).—The storage was continued in the saturated atmosphere for a further period of 21 days and the briquettes were then immersed in water for further periods of 28 and 63 days respectively.

The results (in lb. per sq. inch) obtained in these series of tensile strength tests are shown in the following tables :—

(1) *Briquettes composed of* 8·7 *parts of standard sand to* 1 *part of slaked lime by weight (equivalent to* 10:1 *by weight of lump lime before slaking) gauged with* 10·5 *per cent. of water.*

	Nyasaland Hydraulic Lime.						Commercial Grey Stone Lime.					
	At 28 days		At 56 days		At 91 days		At 28 days		At 56 days		At 91 days	
	series (a)	(b)	series (a)	(b)	series (a)	(b)	series (a)	(b)	series (a)	(b)	series (a)	(b)
	20	Not made.	28	32	42	46	14	Not made.	64	57	71	71
	15		36	34	38	50	14		57	57	71	85
	20		32	33	34	48	14		50	57	71	85
	20		29	37	34	48	28		43	50	71	71
	15		37	36	38	44	14		43	50	71	71
	15		33	32	42	50	21		57	57	71	78
Mean	17		33	34	38	47	17		52	55	71	77

(2) *Briquettes composed of* 4·35 *parts of standard sand to* 1 *of slaked lime by weight* (*corresponding to* 5:1 *by weight of lump lime before slaking*) *gauged with* 14 *per cent. of water.*

	Nyasaland Hydraulic Lime.						Commercial Grey Stone Lime.					
	At 28 days		At 56 days		At 91 days		At 28 days		At 56 days		At 91 days	
	series (a)	(b)	series (a)	(b)	series (a)	(b)	series (a)	(b)	series (a)	(b)	series (a)	(b)
	37	Not made.	55	44	62	90	43	Not made.	78	85	128	113
	37		55	50	74	82	43		85	92	128	85
	37		55	55	72	80	43		86	78	128	85
	37		55	52	70	90	35		85	78	113	85
	37		58	54	72	90	36		99	92	121	99
	37		54	44	64	90	43		85	92	128	113
Mean	37		55	48	69	87	41		86	86	124	97

The above results show that the Nyasaland hydraulic lime mortar gradually increased in strength under the damp-air and water treatment (series a and b) and although the strength developed under these conditions was inferior to that shown by good quality commercial hydraulic lime, it possessed a very fair strength.

The results obtained with the briquettes stored in water (series b), indicated that brickwork laid with mortar prepared with this lime would not be affected adversely in exposed situations. Owing to the large amount of free lime present, the addition of coal ashes or ground brick to the mortar might be tried, as this should increase its strength materially.

It is evident, therefore, that the Nyasaland product would be quite suitable for those purposes for which feebly hydraulic limes are usually employed.

Grappier Cement.

The grappiers which were left upon the 50-mesh sieve after the separation from the hydraulic lime (see p. 306) were ground fine, leaving a residue of 23 per cent. on a sieve having 180 meshes per linear inch and 5·4 per cent. on a sieve having 76 meshes per linear inch, and were aerated for three days before being tested.

A representative sample of the grappier cement after grinding was submitted to chemical analysis with the following results :—

		Per cent.
Lime	CaO	47·88
Magnesia	MgO	1·49
Ferric oxide	Fe_2O_3	0·50
Alumina	Al_2O_3	3·30
Sulphuric anhydride	SO_3	0·30
Silica (free)	SiO_2	19·18
Silica (combined)	SiO_2	14·06
Loss on ignition	$\left\{\begin{matrix} H_2O \\ CO_2 \end{matrix}\right\}$	11·36

The above analysis shows that a considerable proportion of the silica had not entered into combination with the lime and hence the cement contained a large proportion of inert material.

Setting Time.—The cement, gauged with 31 per cent. of water, had an initial setting time of six hours and had not set completely at twenty-four hours after gauging.

Soundness.—Pats consisting of the neat cement gauged with 31 per cent. of water, kept in damp air and water, at three months after gauging showed no signs of expansion or contraction and were perfectly sound and hard.

Tensile Strength.—Mortar briquettes were made from the following mixtures :—(1) 10 parts of standard sand to one of grappier cement and (2) 5 parts of standard sand to one of cement by weight. These mixtures were gauged with 7·1 per cent. and 14·6 per cent. of water respectively. The briquettes thus produced were treated in a manner similar to those containing hydraulic lime (see p. 307) so far as the quantity of material available would permit. The tensile strengths of the briquettes (in lb. per square inch) are shown in the following tables :—

Briquettes composed of 10 parts of sand to 1 part of grappier cement.

	At 28 days Series (a)	At 28 days Series (b)	At 56 days Series (a)	At 56 days Series (b)	At 91 days Series (a)	At 91 days Series (b)
	30	Not made.	Not made.	31	Not made.	48
	25			34		44
	25			32		50
	30			—		—
	—			—		—
Mean	27			32		47

Briquettes composed of 5 parts of sand to 1 part of grappier cement.

	At 28 days Series (a)	At 28 days Series (b)	At 56 days Series (a)	At 56 days Series (b)	At 91 days Series (a)	At 91 days Series (b)
	35	Not made.	Not made.	42	Not made.	76
	40			38		80
	40			50		76
	42			—		—
	—			—		—
Mean	39			43		77

The above results show that the grappier-cement mortar developed practically the same tensile strength as the hydraulic lime mortar when tested under the same conditions (see p. 308). Hence the separation and grinding of the grappiers offers no advantages so far as the production of a stronger mortar is concerned, but their removal from the hydraulic lime is necessary in order to ensure a sound product. It is therefore evident that the most economical procedure will be to burn the limestone at such a temperature as will secure the maximum yield of hydraulic lime with the minimum quantity of grappiers.

Natural Cement.

When burning the limestone for a natural cement the irregular distribution of the lime due to the presence of veins of calcite necessitated the exercise of special care to avoid fusion as far as possible. The limestone was burnt at a temperature between 1050° C. and 1100° C. for 5 hours, the fused portions, which amounted to 8 per cent. of the total, being discarded as they were found to possess no hydraulic properties. The remainder of the burnt material was sprinkled with water and left for three days in order to allow the free lime to slake, after which the whole was ground fine, leaving residues of 18 and 5 per cent. on sieves having 180 and 100 meshes per linear inch, respectively. It was found necessary to add 1½ per cent. of finely ground gypsum to the ground cement in order to lengthen the setting time and so bring it within working limits.

The natural cement on chemical analysis gave the following results :—

		Per cent.
Lime	CaO	55·19
Magnesia	MgO	1·44
Ferric oxide	Fe_2O_3	0·45
Alumina	Al_2O_3	2·52
Sulphuric anhydride	SO_3	0·87
Silica (free)	SiO_2	17·85
Silica (combined)	SiO_2	8·62
Loss on ignition	$\left\{\begin{matrix} H_2O \\ CO_2 \end{matrix}\right\}$	12·18

Setting Time.—The natural cement, so obtained, when gauged with 41 per cent. of water, had an initial setting time of 1¾ hours and a final setting time of 2 hours 50 min. when tested with the Vicat apparatus.

Soundness.—Two pats composed of neat cement gauged with 41 per cent. of water were kept in moist air for a period of 24 hours, after which one of the pats was left in moist air and the other immersed in water for a period of three months, but in neither case did the pats show any signs of distortion or cracking.

Tensile Strength.—Briquettes were made with (1) neat cement gauged with 41 per cent. of water and (2) a mixture of two parts of standard sand and one part of cement gauged with 15 per cent. of water, the briquettes being compacted in the moulds by thumb pressure only. The briquettes after gauging were left in the moulds in a damp atmosphere for 24 hours and then removed and stored in water until due for breaking.

The results obtained (in lb. per sq. in.) in the two series of tests were as follows :—

Neat Cement.

	At 24 hours.	At 7 days.	At 28 days
	37	31	70
	37	37	72
	37	31	78
Mean	37	33	73

Cement with two parts of Standard Sand

	At 7 days.	At 28 days.
	25	58
	25	60
	25	60
Mean	25	59

A good quality natural cement when tested neat under the above conditions should develop a tensile strength of about 125 lb. per sq. in. at 7 days and 225 lb. at 28 days after gauging. The cement-sand briquettes under similar conditions ought to show tensile strengths of about 75 lb. and 140 lb. respectively at 7 and 28 days after gauging. The material under consideration contains a large proportion of free lime and on that account cannot be regarded as a natural cement of good quality.

As the mortar made from this natural cement developed only the same strength as was obtained from the hydraulic lime under the same conditions, the increased cost of producing the natural cement would not be justified.

Upper Shire District.

The floor of the old lake Malombe, which covers about 100 square miles, is composed of a light-grey calcareous clay at least 10 feet deep. Locally, there are considerable deposits of shells. In view of the extent of the deposit and the probability that it can be worked easily, samples of the calcareous clay were collected by the Government Geologist and sent to the Imperial Institute for analysis and technical trial

These samples were as follows :—

No. 7.—" Calcareous clay from the floor of the old lake Malombe, Upper Shire." This consisted of a fine-grained earthy limestone containing a few frustules of diatoms.

No. 7a.—" Shelly clay from the floor of the old lake Malombe, Upper Shire." This small sample was closely similar to No. 1, but was more argillaceous and contained numerous small gastropod shells. As it seemed probable that such material would be liable to considerable variation in composition from point to point, no analysis was made.

The sample of calcareous clay (No. 7) was submitted to chemical analysis with the following results :—

		Per cent.
Lime	CaO	35·97
Magnesia	MgO	2·19
Alumina	Al_2O_3	7·83
Ferric oxide	Fe_2O_3	2·73
Sulphuric anhydride	SO_3	0·41
Silica (free)	SiO_2	1·50
Silica (combined)	SiO_2	11·76
Loss on ignition	$\left\{\begin{matrix} H_2O \\ CO_2 \end{matrix}\right\}$	38·00

For use in the manufacture of Portland cement, this material should be mixed with a siliceous limestone containing about 15 per cent. of silica. If, instead of a siliceous limestone, a fairly pure limestone be used for admixture, finely ground silica (sand) should also be added.

This limestone would not be suitable for the economic production of hydraulic lime.

The above analysis indicated that the material might give a natural cement if burnt at a suitable temperature, particularly as the free silica present was finely divided and only small in amount.

Preliminary burning trials were accordingly carried out and these gave the most promising results when the material, broken to pass a 1½-inch ring, was burned at a temperature of 1,050° to 1,100° C. The slightly sintered material was next ground fine, only 15 per cent. failing to pass a standard sieve having 180 meshes to the linear inch. The setting time of the ground product was then adjusted by the addition of 2 per cent. of ground gypsum, and the mixture aerated for five days in order to ensure its soundness.

The natural cement so produced gave the following results on chemical analysis :—

		Per cent
Lime	CaO	56·86
Magnesia	MgO	3·34
Alumina	Al_2O_3	9·36
Ferric oxide	Fe_2O_3	3·09
Sulphuric anhydride	SO_3	1·35
Silica (free)	SiO_2	1·21
Silica (combined)	SiO_2	21·02
Loss on ignition	$\left\{\begin{array}{l} H_2O \\ CO_2 \end{array}\right\}$	2·72

The above analysis showed that the burning had been satisfactorily carried out. The cement was submitted to the usual physical tests with the following results :—

Setting Time.—The cement when gauged with 33 per cent. of water had an initial setting time of 20 minutes and had set hard in 25 to 30 minutes.

Soundness.—Pats of the neat cement gauged with 33 per cent. water, after being stored (a) in moist air and (b) in water for three months, remained quite sound, showing no signs of expansion or contraction during that period.

Tensile Strength.—As the quantity of cement available was small, only the more useful cement-sand test was made.

The briquettes, composed of one part of cement to two parts of standard sand, were gauged with 13·2 per cent. of water and compacted into the moulds by thumb pressure only. They were left in a damp atmosphere for 24 hours and then removed from the moulds and stored in water until due for breaking.

The results obtained in lb. per sq. in. were as follows :—

Cement with two parts of Standard Sand.

	Tensile strength. At 7 days after gauging.	Tensile strength. At 28 days after gauging.
	160	190
	160	170
	164	180
Mean	161	180

These results are quite satisfactory, the briquettes showing a good increase in strength between the 7- and 28-day tests, whilst the mean strength attained in each case compares favourably with that recorded for good quality natural cement which, when tested under the same conditions, gave about 75 lb. and 140 lb. at 7 and 28 days respectively.

It is evident from the above results that the calcareous material from the bed of the old lake Malombe, if burnt under suitable conditions, will give a natural cement of good quality.

Two further samples of limestone were forwarded for examination, by the Government Geologist, late in 1925. These consisted of :—

No. 8.—A pinkish crystalline limestone, from M'pimbi, about 14 miles north-west of Zomba, containing much mica and lime-silicate minerals.

No. 9.—A cream-coloured clayey limestone containing much fine sand, which had been obtained from near Balakas Ginnery on the Liwonde-Ncheu road, near the western boundary of the Upper Shire district.

The following results were obtained on submitting representative portions of the limestones to chemical analysis :—

		No. 8. Crystalline Limestone. Per cent.	No. 9. Clayey Limestone. Per cent.
Lime	CaO	50·25	44·78
Magnesia	MgO	3·63	1·77
Ferric oxide	Fe_2O_3	0·69	1·61
Alumina	Al_2O_3	1·72	4·58
Silica (free)	SiO_2	4·22	9·38
Silica (combined)	SiO_2		1·12
Sulphuric anhydride	SO_3	0·02	trace
Loss on ignition	$\left\{\begin{matrix} H_2O \\ CO_2 \end{matrix}\right\}$	39·90	37·10

The above analyses indicate that the clayey limestone is quite suitable for use in the manufacture of Portland cement to comply with the British Standard Specification, but for this purpose it would have to be used in conjunction with more siliceous clayey limestone. The present clayey limestone if calcined alone would yield only a feebly hydraulic lime.

The crystalline limestone, owing to its magnesia content, could not be used for making Portland cement conforming to the requirements of the British Standard Specification, but if used with a suitable argillaceous limestone or siliceous clay it would yield a Portland cement conforming to the United States or German specifications.

Plant necessary for making Natural Cement.

In view of the possibility of a small plant for making natural cement being required in Nyasaland, the Imperial Institute, at the request of the Government Geologist, obtained estimates for suitable plant from several makers of cement-making machinery in the United Kingdom.

The following is a brief summary of a quotation for a typical simple form of plant suitable for a small output of 40 to 50 tons of natural cement per week.

It has been assumed that, in view of the small output required, hand labour would be utilised as far as possible for getting the stone, and that no mechanically operated conveying plant would be necessary on the works.

The specifications and estimated cost (f.o.b.) of the plant is as follows :—

	£	s.	d.
Kiln.—Intermittent dome kiln for burning 40 to 50 tons of natural cement per week, capable of being fired by wood, coal or coke. Cost, including ironwork, grate-bars, fire-bricks, but not masonry for backing	260	0	0
Crusher.—10 in. × 7 in. crusher, having an output of about 3½ tons per hour of 2-in. cube size and requiring 3 to 5 b.h.p. to drive it . . . . . cost	80	0	0
Grinding Mill for cement.—Compound ball tube mill, 13 ft. × 3 ft. 6 in., with automatic feed and bagging mouthpiece and necessary shafting, the whole requiring about 21 b.h.p. to drive . . cost	625	0	0
Power Plant.—Semi-portable steam engine, 19 to 26 b.h.p. . . . . cost	281	10	0

It is seen, therefore, that the above plant, which represents practically the minimum upon which it is possible to operate, would cost about £1,300. To this must be added, however, the cost of the factory and store buildings, transport of plant to Nyasaland and its erection at the works.

Notes on the Deposits.

For the following notes regarding the deposits from which the foregoing samples were obtained, the Imperial Institute is indebted to the Government Geologist.

The deposits are numbered and dealt with in the same order as were the samples in the preceding report.

Sample No.	Character and extent of deposit.	Fuel available.	Accessibility of deposit.	Roads and transport to possible centres of consumption of cement.
1 (see p. 303)	Superficial clay of wide extent and ranging up to 10 ft. in thickness.	Wood fuel, also coal in Rumpi Gorge, Tekero, and west of Young's Bay, at a distance of several miles in a direct line, but transport conditions difficult.	Deposit stands about 2,600 ft. above Lake Nyasa; well situated for working.	Connected with Lake Nyasa by good road about 10 miles long. Head transport available, mechanical transport possible.
2 (see p. 304)	Karroo clay, of wide extent, not less than 15 ft. in thickness; gentle dip; well exposed on floor and sides of Manchewe Valley.	Do.	Do.	Do.
3 (see p. 304)	Karroo clay, of wide extent, gentle dip, and not less than 10 ft. in thickness. Well exposed, in vicinity of Mission, in shallow depression, over an area several hundred yards in diameter.	Do.	Do.	Do.
4 (see p. 304)	Bedded Karroo limestone, 20 ft. thick, gentle dip; exposed in banks of stream. Beds vary considerably in composition.	Coal exposed in Rumpi Gorge at a distance of several hundred yards. Wood fuel also available.	Situated at bottom of steep - sided valley.	Reached from Livingstonia Mission by a native track traversing several miles of very hilly country.
5 (see p. 304)	Nodular limestone in marly matrix, the whole forming a bed 3½ ft. thick interbedded with the limestones of No. 4.	Do.	Do.	Do.

Sample No.	Character and extent of deposit.	Fuel available.	Accessibility of deposit.	Roads and transport to possible centres of consumption of cement.
6 (see p. 304)	Numerous beds of gently dipping nodular limestones interbedded with Karroo mudstones. Exposed on a low ridge about 50 ft. high and distant less than 1 mile from lake shore at mouth of Rumpi River, several miles south of Chitimwe, Florence Bay.	As in No. 1 above.	Considerable quantities of the nodules have been weathered out of the mudstones and lie upon the surface; larger supplies readily available by means of shallow workings.	The deposit lies within a mile of Lake Nyasa and the nodules could be shipped without difficulty.
7 (see p. 312)	The deposit forms the floor of a large part of Lake Malombe to a depth of not less than 10 ft.; the lake is fully 100 square miles in area when in flood. The deposit contains numerous shells in some places, and locally large numbers of shells lie upon the surface.	Wood fuel available within a few miles. Coal occurs at Sumbu at a distance of 110 miles.	The margin of the deposit lies less than a mile from the Zomba - Fort Johnston road at a distance of 60 miles from Zomba. The deposit is liable to temporary flooding during the rainy season.	Good road to Zomba, Limbe, and to the Lake shore; available for motor traffic for greater part of the year.
8 (see p. 314)	The deposit takes the form of several lenticles of crystalline limestone, ranging up to 30 ft. in thickness, interbanded with various gneisses and schists which are non-calcareous or only slightly calcareous. The limestones may be white, grey or pink in colour, and they contain varying, but generally low, percentages of magnesia. The limestones are exposed on a low hillside about two miles distant from the Shire River.	Wood fuel.	The deposit lies about 14 miles north-west of Zomba, and near the Shire River.	The road to Zomba is not at present good for motor transport, and it has to climb a steep scarp nearly 1,500 ft. high.

Sample No.	Character and extent of deposit.	Fuel available.	Accessibility of deposit.	Roads and transport to possible centres of consumption of cement.
9 (see p. 314)	The deposit has been formed by the precipitation of calcium carbonate at or near the surface of the ground along the side of a broad shallow depression or dambo. It is not less than 8 ft. in depth and it is of large but uncertain extent. White crystalline limestone outcrops in the vicinity.	Wood fuel available.	The deposit lies in open country and is well situated for working.	The deposit is crossed by the main road from Zomba to Ncheu at a distance of about 60 miles from Zomba.

ARTICLE.

THE AUSTRALIAN MINERAL INDUSTRY.

General.

The total recorded value of the mineral production of the Commonwealth, up to the end of 1924, was nearly 1,100 million pounds sterling. This was contributed by the various States as shown in the following table :—

	£
New South Wales	385,028,000
Victoria	312,003,000
Queensland	141,929,000
South Australia	42,125,000
Western Australia	161,913,000
Tasmania	50,640,000
Northern Territory	3,380,000
	£1,097,018,000

These are remarkable figures considering that the total population of the Commonwealth was only 5,435,734 at the last census in 1921, and that the above production figures date principally from 1851, when the total population was about 405,000. About 80 per cent. of the total value is represented by gold, silver, lead and coal. The remaining value represents nearly all minerals of economic importance, the

variety of Australia's mineral wealth being remarkable. In 1924, the total Commonwealth production of minerals and metals was valued at £26,877,000, the highest figure reached since 1907, when the output was valued at £28,301,346. Complete figures for 1925 are not yet available, but they are likely to show a further increase over 1924. It is interesting to note the change in relative values of gold and coal won, showing that with the growth of industrialism in the Commonwealth the fall in gold has been practically balanced by the rise in coal.

Commonwealth Production

	1907.	1924.
	£	£
Gold	13,515,109	2,873,124
Coal	3,302,974	11,615,570

While this is true of the Commonwealth as a whole it is far from true as regards individual States. The decline in output of gold has been principally in Victoria, New South Wales and Western Australia, while the increase in output of coal has been chiefly in New South Wales.

The outlook, however, for the mineral industry of the Commonwealth as a whole appears to be very promising as will be shown below when dealing with individual States. More intensive prospecting is in progress, the importance of this being recognised by the provision of funds by each State as well as by the Commonwealth Government. In the financial year 1924–1925, over £42,000 was expended on prospecting by the various States themselves, while £40,000 out of the Federal surplus is to be set aside for encouragement of prospecting for precious metals in the current year.

Gold and copper are the only important heads under which the present outlook is discouraging. In the case of gold the decline in production has continued for many years, and the only remedies would appear to be the discovery of new deposits, such as the bonanzas discovered in the early days, or more economical methods of production in the older fields. Copper is the only important base-metal of which the post-war price is little better than that before the war. The higher costs involved in production have, therefore, hit the copper industry in Australia rather badly. Improved metallurgy and changed methods of working, however, may result in many important mines being re-opened in the near future. Every State in

the Commonwealth has large areas which have not been thoroughly prospected, and in which there is every reason to expect that further discoveries will be made.

Important inquiries have been held in recent years into certain aspects of the mineral industry. This fact shows that its importance is fully recognised by the Government. In New South Wales a Select Committee reported in 1922 on the metal industry. In Western Australia a Royal Commission reported in 1925 on the mineral industry of that State, and made numerous suggestions for arresting the decline in production from the Boulder Belt.

Great interest has been shown and much money has been spent in the search for oil in Australia and Papua. A series of reports have been made to the Federal Government on the prospects for finding oil in commercial quantity on the mainland, and £50,000 has been allocated on a £1 for £1 basis to assist exploration in approved situations in New South Wales, Western Australia and Queensland. In addition, New South Wales and South Australia have offered £10,000 and £5,000 respectively as a bonus on the first 100,000 gallons of petroleum produced within the State.

New South Wales.

The mineral production of New South Wales was of record value in 1924, and, according to preliminary figures issued by the Minister for Mines, that of 1925 was higher still, being worth £19,108,991. Of this, coal accounted for £9,302,515; silver, lead and zinc, £6,342,992 (mainly from Broken Hill); cement, £1,320,698; pig-iron from New South Wales ores, £500,000; and tin, £250,944. A great variety of other minerals contributed to the total, interesting items being precious opal (£10,030) and platinum (£11,061).

The coal resources of New South Wales are the most important in Australia. Sydney is the centre of the principal basin, which extends along 150 miles of coastline from Newcastle southwards to the Shoalhaven River. The maximum width is 150 miles from Newcastle to near Dubbo. At Sydney the coal is about 3,000 feet from the surface, but it crops out at Newcastle on the north, at Bulli in the Illawarra district in the south, and at Lithgow to the west. The coal seams are of Permian age and cover an area of about 15,000 square miles, of which 1,200

square miles have been proved by development or other means. In the proved area it is estimated that there are about 20,000 million tons of coal available, classified as follows :—

	Tons.
High-grade, suitable for steam raising, gas, coking and household purposes . .	6,800,000,000
Second grade, of lower calorific value and containing more ash	5,000,000,000
Third grade	8,150,000,000

The potential reserves in the undeveloped portion of the basin are very great. Assuming that the quantity per acre in the unproved area is only 40 per cent. of that in the proved area, the potential reserves would amount to a further 100,000 million tons.

The principal workings are in the Northern, Maitland-Cessnock, Southern, and Western coalfields, and at Muswellbrook and Gunnedah. The Maitland-Cessnock area, extending over a distance of about 15 miles, is responsible for about half the output of the State. The seams worked in this area are the Greta seams, of which the upper varies from 14 to 32 feet in thickness and the lower from 3 to 11 feet.

Other basins of Permian coal have been found at Coorabin, Ashford, and the head of the Clyde River. Borings and shafts have proved the Coorabin basin for a length of 5 miles and a width of 3 miles.

Triassic coal occurs in the north-eastern part of the State and at least five seams ranging from 2 to 37 feet in thickness are known. So far, however, they have been found to be made up principally of shale bands, although a 3-feet seam of clean coal is being worked just over the border by the Queensland Government. This seam probably extends into New South Wales near Koreelah Creek, one of the head tributaries of the Clarence River, and may be mined in the future.

The coal industry of New South Wales is increasing steadily in importance. About half the output of coal is exported to other States and elsewhere, but the consumption in New South Wales itself is increasing more rapidly than the exports. This is due, no doubt, to the development of manufacturing industries, more particularly the iron and steel industry, which depends on ore from South Australia. The Broken Hill Proprietary Company's steelworks at Newcastle consume about 800,000 tons of coal per annum. Another growing use for coal as fuel

is in the manufacture of Portland cement, of which 272,300 tons were produced in 1924 and 304,089 tons in 1925. Three plants are already producing and several others are building or projected.

Iron-smelting in New South Wales dates from 1852, when the Fitzroy Ironworks were established at Mittagong. These were never really successful, but the Eskbank Ironworks, at Lithgow, after many vicissitudes, became firmly established about 1908 and have been extended to develop an output of over 90,000 tons of pig-iron per annum from New South Wales ores. The total reserves of iron ore in the State are estimated at about 53 million tons, but most of the deposits are small, the only important one being that at Cadia, near Orange, where the minimum quantity available is about 39 million tons.

The steel industry of New South Wales was established at Newcastle during the war by the Broken Hill Proprietary Company, Limited, and has become of great importance. For the year ended 31st May 1925, the production of these works was 358,861 tons of pig-iron and 331,137 tons of steel ingots. The capacity of the works is about 450,000 tons of pig-iron per annum. As already stated, they depend upon South Australia for iron ores. The plant consists of three large blast furnaces which are supplied with coke by 224 Semet Solvay ovens recovering sulphate of ammonia, benzol, etc., as by-products. About 500,000 tons of coal per annum is carbonised in these ovens. In addition, there is a smaller blast furnace for the production of ferro-manganese and special foundry irons. The basic open-hearth steel plant consists of seven 60-ton furnaces, each capable of producing 1,500 tons of steel per week. The rolling-mill plant comprises a blooming mill; a rail, structural and billet mill; three merchant mills; and a rod mill. A steel foundry, containing an acid open-hearth furnace and a cupola furnace for iron castings, together with machine shops, brass-foundry and pattern shops form other parts of the equipment.

Nearly all the silver, lead and zinc is produced at the famous Broken Hill mines in the west of the State, but important deposits are worked also in the Yerranderie district and elsewhere.

Tin is widely distributed in New South Wales both in alluvial and lode deposits, but the output is somewhat uncertain owing to the dependence of alluvial workings upon an irregular rainfall. All the concentrates produced are smelted in the State. At the present price of tin an increased output is probable.

The "kerosene shales" of New South Wales are large potential sources of oil, and have been the basis of a profitable industry for many years. Since the war, however, costs have been too high and practically the only work now in progress on these deposits is of an experimental nature.

VICTORIA.

Coal and lignite together form the chief item of mineral production in Victoria, the value of these being £610,671 in 1924. Gold production, which averaged over nine million sterling per annum from 1851 to 1860, was only worth £285,316 in 1924 and about £201,000 in 1925.

The brown-coal deposits of Victoria cover an area of 1,200 square miles. They attain an extraordinary thickness at Morwell where 780 feet of coal were disclosed by a bore 1,010 feet deep. The chief deposits occur at Lal Lal, near Ballarat; Altona-Laverton and the Werribee Plains, west of Melbourne; Morwell in the Latrobe Valley of Central Gippsland; and Allerton, near Port Albert, in Southern Gippsland. Owing to faulting, the beds occur at varying depths from the surface. At Morwell they are within 30 feet of the surface and at Traralgon the cover is about 500 feet. The reserves of brown coal in the two last-mentioned areas are estimated at 10,000 million tons, while the total reserves of brown coal in the State are officially estimated at not less than 30,000 million tons. Another estimate gives 20,000 million tons of brown coal as workable by open-cut in the Latrobe Valley alone. The coal contains about 60 per cent. of moisture and has a calorific value as mined of 4,700 B.Th.U. The analysis of the dry coal is as follows:—

	Per cent.
Carbon	61·9
Hydrogen	5·6
Oxygen	27·9
Nitrogen	0·8
Sulphur	0·2
Ash	3·6

The State Electricity Commission is carrying out an important power scheme in connection with the Morwell deposits, which are being worked opencast. A power station with an initial capacity of 50,000 kilowatts is being erected close to the open cut at Yallourn, in connection with a receiving station at Yarraville, whence the power will be transmitted throughout all parts of the State within practicable range of the generating station. A temporary power station is already operating at Yallourn as well as a large briquetting plant.

Victoria has small deposits of bituminous coal, the most important being at Wonthaggi, where the reserves are estimated at 20 million tons. This mine is operated by the State and accounts for about 90 per cent. of the total output of black coal in Victoria.

Victoria has, at Costerfield, the most important antimony deposits in the Empire, but work on them has ceased recently. It was reported at the end of 1925 that a deposit of manganese ore at Heathcote was being developed.

In evidence given before the Royal Commission on Outer Ports Development, a geologist of the Mines Department stated that there were large deposits of brown coal worth developing in Eastern Gippsland, that there was probably 400 million tons available near Yarram, and that salt deposits of potential value occurred near Welshpool.

It has been reported recently in the press that alluvial deposits of tin ore have been discovered in the Beenak district and of osmiridium in South Gippsland.

QUEENSLAND.

The interest taken in the mineral development of Queensland is shown by the monthly issue of the *Queensland Government Mining Journal*, an official chronicle of current work and general mining information. Coal and arsenic mines are operated by the State as well as copper and lead smelters. The mineral wealth of Queensland is undoubtedly very great and comprises nearly all minerals of economic importance. New discoveries are constantly being made.

The production for 1925, excluding gold, coal and precious stones, was valued at approximately £743,000 as compared with £836,000 in 1924. In the latter year the total production was valued at £2,266,461, of which coal accounted for £985,542

and gold for £419,851. There were decreases last year in gold, copper, limestone, arsenic and cobalt, but in the case of the first three this was due to the temporary closing down of the Mount Morgan mine. The heavy fall in the price of arsenic was followed naturally by a decrease in production. Lead showed an increase in value of over £62,000 in 1925, the total value being £187,681. During the year vigorous development was continued in the Mount Isa silver-lead field, Chillagoe district, where what is stated to be another Broken Hill has been discovered. The original discovery was made in March 1923, and was immediately recognised as of outstanding importance. Four principal lines of lode have been opened up, viz., Mount Isa, Black Star-Ibus, Black Rock-Out-on-Her-Own, and Rio Grande. They occur in a main lode-channel which has been traced for about 2¼ miles north and south and for over ½ mile in width. The country rock consists of shale, sandstone, etc., belonging to the Cloncurry Series, which is probably of Silurian age or older. The oxidised ore, which extends to a depth of more than 100 feet, averages about 15 per cent. of lead and 5¼ oz. of silver per ton. In the sulphide zone, zinc makes its appearance without appreciable change in the other values, so that the sulphide ore is likely to yield more profit. By the end of 1924, developments had been so favourable that it was decided to apply to the Queensland Government for an extension of railway facilities to the field. After investigation by the Public Works Commission the application was granted, and the railway is now under construction from Duchess, 60 miles from Mount Isa, on the Cloncurry-Townsville line. The two principal holdings in the field have now been amalgamated as the Mount Isa Mines, Ltd., and preparations are being made, pending completion of the railway, to erect a 30-ton pilot plant and to open up the Black Star lode for steam-shovel working. This lode is now proved for an average width of 200 feet and a length of 2,023 feet and can be worked very cheaply. According to the Chief Government Geologist, the Black Star-Ibus lode is the most important in regard to tonnage and has the greatest width of payable ore of any known payable lode in the Commonwealth. About the middle of 1925, he estimated that there were 3,560,000 tons of ore proved in this lode, containing 9½ per cent. lead and 2·5 oz. silver per ton, with a gross value of £11,370,000.

The ore-body traversing the Black Rock and Out-on-Her-Own leases has been proved, over a length of 635 feet and a width of 35 feet, to contain 320,000 tons to a depth of 200 ft. assaying 25 per cent. lead and 12 oz. silver per ton with a gross value of £3,000,000. The ore in the Rio Grande line was valued at £3,000,000 and that in Mount Isa at £200,000. More recently the latter lode has been developing more favourably, while all the lodes appear to be of higher grade below water level as shown by the following assays of samples from the deepest workings.

Lode.	Depth. *Ft.*	Lead *Per cent.*	Zinc *Per cent.*	Silver. *Oz. per ton.*
Mount Isa . .	300	19·0	—	6·0
Black Star . .	270	20·2	8·2	8·5
Black Rock .	270	28·4	—	31·4
Rio Grande. .	210	29·5	7·6	24·2

The latest report issued by the Company, dated 31st December 1925, gives the following estimates of ore to the depths stated, based on development work done to date:—

Lode.	Depth. *Ft.*	Lead. *Per cent.*	Silver. *Oz. per ton.*	Long Tons.
Mount Isa . .	300	10	tr.	123,000
Black Star . .	200	9	3	3,700,000
Black Rock .	300	23	9	336,000
Rio Grande. .	200	16	8	136,000

In addition to the above, there are many other lodes which have given very satisfactory results at the surface and will be developed later. Considerable interest has been aroused recently by the discovery of lode outcrops on the bank of the Leichhardt River opposite Mount Isa.

Other deposits of lead ore are being opened up in Queensland, notably the old Consuls mine at Chillagoe and the Lawn-Hill field in Burke county.

Important copper deposits have been developed in Queensland and over 20,000 tons of copper were produced annually before the war. High cost of wages together with industrial unrest and comparatively low prices for copper have resulted in many mines being closed down, including the famous Mount Morgan mine and most of those in the Hampden-Cloncurry district. New methods have been devised to meet the situation and a considerable revival in the copper production seems probable.

Queensland is also an important producer of tin ores, both from alluvial and lode deposits. In 1925, the total production of tin ore was 1,012 tons, valued at £161,500. Present prices of tin have stimulated interest in prospecting and several companies have been formed recently to develop new deposits or re-open old mines. It is expected that there will be greatly increased activity in tin mining when the Amending Act, authorising entry on all freehold lands, comes into operation. Many of the old freeholds in the Stanthorpe field are known to contain rich deposits of tin ore.

Fluorspar has recently figured in the mineral production of Queensland, the output being 1,864 tons and 4,227 tons in 1924 and 1925 respectively, valued at £5,240 and £13,371.

Determined efforts are being made to establish the presence of petroleum deposits in Queensland, and drilling is in operation at several localities. Natural gas, yielding appreciable quantities of petrol, has been proved to occur at Roma.

South Australia.

South Australia is the chief producer of iron ore in the Commonwealth and contains the largest lead-smelter in the Empire, possibly in the world. In 1924, the mineral production was valued at £953,238, of which iron ore (572,997 tons) accounted for £667,354 and salt £141,046. Copper was at one time the principal item of mineral production, from the Wallaroo and Moonta mines which closed down in 1923. At present the small copper output is obtained from re-treatment of tailings at Moonta, and prospecting operations at the Wild Dog mine, Yelta.

The production of iron ore from the Iron Knob district on a large scale dates from 1915, when the steelworks at Newcastle (New South Wales) commenced work. With the exception of 1922, each succeeding year has shown an increased output.

The Broken Hill Proprietary Company owns four large deposits in the Iron Knob district, viz.: Iron Monarch, Iron Knob, Iron Baron, and Iron Prince. About 180 million tons of ore has been proved in these deposits, consisting principally of haematite, although considerable bodies of magnetite

and some limonite also occur. The quantity of manganese varies appreciably and the ore is mined selectively in order to keep the average feed of the furnaces at about 1 per cent. of manganese. The ore shipped to Newcastle averages about as follows :—

	Per cent.
SiO_2	1·69
Al_2O_3	1·41
Fe_2O_3	93·82 = 65·67 Fe
MnO	1·11 = 0·87 Mn
P_2O_5	0·08 = 0·035 P

Most of the ore at present mined is from the Iron Monarch. The Iron Baron and Iron Prince deposits are not yet producing. The ore-bodies are practically without overburden and rise from 400 to 600 feet above the surrounding plains. They are worked with open-cut faces up to 180 feet high and the broken ore is loaded by steam shovels. It is shipped from Whyalla, 35 miles by railway from the mines, from 10,000 to 17,000 tons being shipped per week.

Salt and gypsum are abundant in the lakes at the southern end of Yorke Peninsula and near the head of Gulf St. Vincent; also at Lake Hart and Lake Macdonnell.

Gypsum, limestone and barytes are also becoming more important.

Radioactive ores have attained some prominence, and work has been resumed lately at Mount Painter, in the Flinders Range, and at Olary.

Arsenic valued at £544 was reported in 1924 for the first time.

Tin has been recorded in the Glenlok district.

At present, South Australia is dependent upon other States for its fuel supplies, although important deposits of brown-coal have been proved by boring. These, however, are difficult of access, low-grade, and occur at some depth. A report made recently to the Government after special investigation points out that there are good prospects of shallower deposits being found within reasonable distance of Adelaide and a boring campaign is recommended.

The hinterland of South Australia still awaits development. The Flinders Range is known to be mineralised and new discoveries are likely to be made with the growth in population and facilities of communication.

WESTERN AUSTRALIA.

The production of Western Australia in 1924 was valued at £2,581,162, of which gold accounted for £2,060,298 and coal £363,255. In 1925, the output of gold was valued at £434,530 (Kalgoorlie £304,892). This serious fall in gold production led to an inquiry by a Royal Commission which reported in June, 1925, making many recommendations for the re-organisation of the industry. The famous Boulder Belt, including the Golden Mile, the mines of which have paid well over £16,000,000 in dividends, still contains enormous quantities of ore that would be considered payable in any other part of the world. No doubt there is still a bright future for these mines when costs have been brought down to normal and the industry re-established on a modern basis. It may well be that the record value of gold produced, £8,770,719 in 1903, will then be exceeded. According to Sir Edgeworth David all the evidence shows that there must still be a very large amount of unexploited alluvial and reef gold in Western Australia and that important discoveries are likely to be made in alluvial deposits or ancient river channels. An instance of the possibilities is given by the recent clean-up of two prospectors in the Mount Magnet district, who obtained 167 oz. of gold from 21 tons of ore treated and 560 oz. of gold from 125 lb. of picked ore. The monthly notes issued by the Mines Department are constantly recording new discoveries.

Renewed interest has been shown lately in deposits of lead ore, of which there has been a considerable production in past years, chiefly from the Northampton field. The Braeside mine, in the north-west of the State, appears to have been developing favourably in 1925, with Government aid. Western Australia possesses important deposits of tantalite that are likely to be more actively worked in view of the new uses for tantalum now being developed. Alunite has been discovered recently at Campion, 20 miles north of Burracoppin, in a surface deposit of considerable promise.

The unworked resources of iron ore in Western Australia are very great, notably on the islands in Yampi Sound where over 97 million tons of high-grade ore exist above water level,

as well as probable reserves of over 450 million tons below water level. The following table gives details of some of the principal deposits :—

Locality.	Ore.	Per cent.					Approximate Reserves, Tons.
		Fe.	SiO_2.	P.	S.	H_2O.	
Yampi .	Haematite	66·07	3·24	·026	·032	0·70	97,000,000
Mt. Hale .	"	65·59	3·14	·076	·037	1·02	—
Wilgie Mia .	"	67·19	1·62	·071	·030	1·37	26,500,000
Tallering .	"	68·66	1·77	·021	·032	n. d.	—
Mt. Gibson .	"	68·10	1·02	·039	·130	1·97	10,000,000
Koolyanobbing	Limonite	61·57	3·07	·008	·050	n. d.	1,000,000
Mt. Caudan .	"	58·02	2·72	·047	·048	8·88	20,000,000
Clackline .	"	53·56	6·13	·111	·076	14·06	—

The absence of coking coals in Western Australia has prevented the exploitation of the iron ore deposits hitherto, but those at Yampi Sound have many favourable features that are sure to be taken advantage of before long. The ore estimated above occurs on Koolan and Cockatoo Islands, the former having 76½ million tons and the latter 20½ million tons, all above water level. The Queensland Government took an option on the Cockatoo Island deposits, in 1920, with the intention of smelting the ore at Bowen, mixed with ore from Cloncurry, but the project was subsequently abandoned. Yampi Sound forms a magnificent harbour with deep water at all stages of the tide and is fully protected from all winds. The ore is of excellent quality, is free from overburden and can be very cheaply mined and shipped. It has been suggested that a coaling station might be established at Yampi in connection with the shipment of ore, the ore-ships bringing coal as a return freight.

TASMANIA.

The Tasmanian mineral production in 1925 was valued at £1,700,861 as compared with £1,496,804 in 1924. The most important items were—copper, £436,661 ; tin, £297,515 ; and lead, £197,452. In addition, the electrolytic zinc plant at Risdon recovered 42,976 tons of zinc and 174 tons of cadmium, valued respectively at £1,560,280 and £38,893, from Broken Hill concentrates.

The Electrolytic Zinc Company of Australasia, Ltd., was formed to remedy the position disclosed by the war, when the closing of the usual outlet for Australian zinc concentrates focused attention on the inconvenience and positive danger to the Empire of allowing concentrates containing 200,000 tons of zinc to be exported each year to continental smelters. The works are at Risdon, near Hobart, where deep-water shipping facilities are available, and are designed for an output of about 47,000 tons of electrolytic zinc per annum. Hydro-electric power to the extent of 33,500 h.p. is supplied by the State electrical works. Hitherto, concentrates from Broken Hill have formed the main supply to the plant, the roasting being done at various existing acid works on the mainland as well as at Risdon itself. About 30,000 tons of sulphur from Australian ores are thus made available for acid manufacture, saving the import of an equivalent quantity from abroad. Practically all the acid made at present in connection with this plant goes into the manufacture of superphosphates.

During the year the experimental concentrating plant of the Electrolytic Zinc Company was successful in establishing a method of treatment for the Mount Read-Rosebery ore, while development at the mines of this belt proved a much larger tonnage than was originally estimated. Over 2,000,000 tons of zinc-lead-silver ore is now practically proved. It may be expected, therefore, that the output of lead and zinc from Tasmanian ores will increase considerably in the future. In 1925, the output of lead was valued at £197,452 and that of zinc at £110,691.

One of the most important developments during 1925 was the discovery of new deposits of osmiridium at Adams river, the production from this source being won in the last six months of the year and valued at £90,300 out of a total for the year of £103,570 for the whole island.

The Mount Lyell copper mines are famous for the developments that have taken place there in the metallurgical treatment of pyritic ores. Smelting has been continuous since 1896, and many years of work are still assured. At the North Mount Lyell mine, ore reserves amount to over a million tons containing 6 per cent. of copper and 1·33 oz. silver and 0·015 oz. gold per ton. In connection with this enterprise,

two railways and a large hydro-electric power plant in Tasmania, as well as chemical works in Western Australia and plants for the manufacture of copper goods in New South Wales, have been established. The Mount Lyell Mining and Railway Company is also interested in the manufacture of superphosphates in South Australia. Further changes in metallurgical practice have been made since the war and pyritic smelting has been abandoned. The ore is now concentrated by jigs and flotation machines before sintering, followed by ordinary blast-furnace treatment. The present output is at the rate of 250 tons of blister copper per week and is being obtained at considerably less cost than formerly.

The tin resources of Tasmania are important and likely to remain so for many years. The famous Mount Bischoff mine is operating in its fifty-third year with increased efficiency. The State hydro-electric plant is being enlarged to meet the constantly increasing demand for power, and efforts are being made to promote the growth of chemical industries in the island. Large quantities of sulphuric acid and superphosphates as well as calcium carbide are already being manufactured.

Tasmania has considerable resources of oil-shale, notably in the Mersey Valley, near Latrobe, where a small distillation works has been established and worked intermittently for many years. Recent investigations have shown that the oil-shale areas are much more extensive than was formerly supposed, and also that the seams are very regular in thickness. In addition to the Mersey Valley areas, new shale deposits have been found at Native Plain, Kimberley, and elsewhere in the northern part of the island, thus proving the continuity of the seams over many miles. The following quantities are estimated in the northern areas :—

Area.	Actual. Long tons.	Probable. Long tons.
Latrobe-Railton	6,260,000	3,460,000
Other areas.	—	3,865,000
Native Plain	3,000,000	4,500,000
Kimberley	—	2,026,000
Merseylea	—	4,500,000
Quamby Brook	211,000	1,043,000
Beulah	387,400	1,490,000
Nook	260,000	3,620,000
Paramatta	22,000	2,400,000
Total	10,140,000	26,904,000

Large "possible" reserves may also occur in these areas in addition to the above. The yield of crude oil from these shales averages about 40 gallons per ton, but varies considerably from point to point, a number of analyses giving from 11 to 65 gallons per ton of oil-shale. The crude oil is dark and viscous and has a specific gravity of 0·932 to 0·953. Much experimental work with different types of retort has been carried out recently and large schemes of development are being considered.

NORTHERN TERRITORY.

The Northern Territory remains largely unprospected, owing to the difficulties of communication and climate. Most of the mining carried out hitherto has been at localities within comparatively easy access of the coast, but sufficient is known of the southern portion, known as Central Australia, to make it certain that as the transport facilities develop so will the mineral production. The total mineral production recorded to the end of June, 1924, was valued at £3,379,737, of which only £18,856 was won in the last twelve months. Over £2,279,448 of the total production has been from gold ores, while tin ores have contributed over £552,822. At present, tin ore is the most important mineral won.

Recent exploration has resulted in discoveries that are stated to be important. Silver-lead and copper ore has been found at Barrow Creek, 150 miles north of Alice Springs; copper ore has been worked near Kilgour river, Borroloola district; and mica in the Hartz Range has been actively worked. The proposed railway from Oodnadatta to Emungalan, connecting Adelaide with Darwin, will pass through broad belts of pastoral and mineral country near the centre of Australia, and lead to more active development of all the resources of this immense territory.

NOTES.

State Aid to Mining in New Zealand.—In a paper read recently at a Dunedin Mining Conference, J. H. Kimbell, Under Secretary of the New Zealand Mines Department and Corresponding Member of the Imperial Institute, gave an account of State aid to mining in New Zealand in which he included some interesting details. In all, fifteen loans have

been made to mining companies since 1913, and three to oil-boring companies. No less than 915 mining companies and prospecting parties have been granted prospecting subsidies by the Mines Department since 1883.

In no other country does the State offer such liberal and varied assistance to miners and prospectors as in New Zealand. During and since the war State aid to mining in this Dominion has been given in several forms, namely: (1) Geological survey and bulletins; (2) Financial aid to prospecting; (3) Government prospecting drills; (4) Loans for mining operations; (5) Schools of mines; (6) Subsidised roads to mining fields; (7) Government water-races.

Geological Surveys and Reports.—Since the first discovery of coal and the precious metals in New Zealand the Government has employed skilled geologists, who have reported, after examination, on all the known mineral deposits.

Since the year 1905 the Geological Survey has made numerous detailed field surveys on a systematic plan, and 20,049 square miles have been geologically surveyed, but the reports based upon the whole of such surveys have not been published up to the present time.

Statutory Provisions Relating to Prospecting, etc.—Under the existing law assistance may be granted for prospecting as under :—

1. Subsidies for prospecting (*vide* Regulation 127 under the Mining Act) :

(*a*) For prospecting new ground by parties of not less than two men, a subsidy not exceeding £1 19*s.* per week per man.

(*b*) For sinking in dry ground by parties of not less than two men: From surface to 15 feet, 1*s.* 11*d.* per foot; from 15 feet to 30 feet, 3*s.* 3*d.* per foot; from 30 feet to 60 feet, 3*s.* 11*d.* per foot; over 60 feet, 5*s.* 2*d.* per foot.

(*c*) For sinking in wet ground where slabbing is necessary, double the foregoing rates. For sinking in solid rock by blasting, 9*s.* 9*d.* per foot; but if the cost exceeds £1 19*s.* per foot, then 13*s.* per foot may be paid.

(*d*) For tunnelling or driving through drift or blue reef: up to 400 feet, 1*s.* 11*d.* per foot; 400 feet to 700 feet, 3*s.* 3*d.* per foot; 700 feet to 1,000 feet, 3*s.* 11*d.* per foot; over 1,000 feet, 5*s.* 2*d.* per foot.

(*e*) For tunnelling or driving through hard rock by blasting, a subsidy of 6*s.* 6*d.* per foot is offered; but if the cost exceeds £1 per foot then 8*s.* 8*d.* per foot may be paid. When timbering by sets is necessary, then a subsidy not exceeding 2*s.* 7*d.* per foot of driving or one-half the cost of the timber may be paid.

2. Subsidies for prospecting deep levels for gold quartz lodes down to a depth of not less than 1,000 feet, and for alluvial drift not less than 250 feet (*vide* Regulation 125, under the Mining Act): such subsidies up to half the estimated cost of the work, but not to exceed £10,000.

The Minister of Finance may from time to time on the recommendation of the Minister of Mines pay to any person engaged in prospecting or pioneer mining a subsidy not exceeding 5*s*. for every £1 expended by such person in prospecting or pioneer mining during the preceding twelve months. Not more than £500 may be paid to any person, nor more than £10,000 in the whole in any one year.

Subject to the provisions of the Mining Acts, loans on a £ for £ basis may be granted for carrying on mining and purchasing and installing plant up to £50,000 in each financial year.

The identification and assaying, free of charge, of samples from *bona fide* prospectors is carried out at the Dominion Laboratory, Wellington, or at the Schools of Mines.

Government Prospecting Drills.—Prospecting drills of various types suitable for the conditions existing in the Dominion are lent to *bona fide* prospectors. A monthly rental is charged for the plant, and the hirer is required to maintain it in good order and condition, as security for which a deposit is required, together with a bond varying in amount according to the class of drill loaned.

When the Government provides an expert drill superintendent to take charge, one-half of his salary, together with one-half of the amount of the authorised travelling allowances and expenses incurred while proceeding from his last employment to the site of the drilling operations, and one-half of his camp allowance while the work is in progress, is paid by the Mines Department; but if the hirer provides the drill superintendent the whole of his salary is paid by the hirer. All working expenses are also paid by the hirer, including renewals, etc., and the loss on carbons.

The hirer is required to furnish to the Mines Department weekly reports of boring results.

Considerable use was made of the Government prospecting drills during 1924, an aggregate of 5,948 feet being drilled in fifty-two holes, of which five were for coal, the remainder being for gold.

Manganese Ore in South Africa.—Important deposits of manganese ore discovered about four years ago in the neighbourhood of Postmasburg, Cape Province, have been examined recently by the officers of the Geological Survey of the Union of South Africa. The deposits referred to occur in the norther

portion of the Cape Province, and extend for about forty miles almost without break from a point about five miles west-north-west of Postmasburg in a northerly direction across the division of Hay into the division of Kuruman. The most convenient access is by way of Kimberley, from which the little village of Postmasburg lies 106 miles to the west-north-west. The nearest railhead, Douglas, is situated 65 miles south-east of Postmasburg and forms the terminus of a branch line which joins the Kimberley-Capetown main line at Belmont.

The bulk of the ore is psilomelane, in good physical condition for export. It occurs as a sheet up to 20 feet in thickness, interbedded in slates and ferruginous conglomerates, dipping to the west at low angles, and forming part of the lowermost beds of the Matsap System, which rests on the limestones of the Campbell Rand Series. The ore is of the ferro-grade, containing from 42 to 58 per cent. of manganese (Mn), 1·75 to 7 of silica (SiO_2), 3·25 to 10·9 of iron (Fe), and no phosphorus. Much ore is exposed at the surface, and opencast mining is practicable.

Assuming an average thickness of four feet, there are approximately 900,000 long tons of ore in sight in the form of residual cappings due to the removal of the overlying sediments by denudation. Along the outcrop of the deposit, where it passes westward under the Matsap Beds, a further 1,800,000 long tons are in sight, assuming an average thickness of eight feet and an exploitation over ten feet on the dip. Further development down to a depth of a hundred feet on the dip would yield an additional supply of approximately sixteen million tons. For fuller details concerning these deposits, including estimates of probable costs of production and transport, reference should be made to a recently-published paper by A. L. Hall entitled "The Manganese Deposits near Postmasburg, West of Kimberley" (*Trans. Geol. Soc. of S. Africa*, 1926, **29**, 17).

Tin Ore in Tanganyika and Uganda.—E. J. Wayland, Director of the Geological Survey of Uganda and Corresponding Member of the Imperial Institute, reports to the Institute that the discovery of cassiterite in the Karagwe district of Tanganyika and the Ankole district of Uganda has led to considerable activity on the part of prospectors, and that extensive areas have been let out under exclusive prospecting licences in Uganda. The cassiterite occurs in surface wash scattered over the hill-sides, and is found in all grades from pea-sizes to lumps weighing several pounds. It is derived from quartz reefs that penetrate the shales, phyllites and schists of the Karagwe-Ankolian series of sediments

which are thought to be pre-Cambrian in age. Up to the present, no reef or alluvial deposit sufficiently constant in yield to be worth working has been discovered. It is noteworthy that the Karagwe-Ankolian sediments are penetrated by large granitic intrusions, to which the quartz reefs are closely related.

Canadian Graphite.—The High Commissioner for Canada has received from the Dominion Department of Mines at Ottawa the following information with reference to Canadian graphite.

Graphite mining in Canada is recovering from the depression from which it has suffered for some years. The industry is now being established on a more healthy and favourable basis, and promises well for the future. The Black Donald mine at Calabogie, Ontario, and the Standard mine at Guenette, Quebec, finding a ready market for their products, are producing to the full capacity of their concentrating plants. The Black Donald is marketing the greater part of its product in the United States, the Standard in Germany and in England.

In the Buckingham district of the province of Quebec, about twenty-five miles north-east of the city of Ottawa, the property of the North American Graphite Corporation was explored by diamond drilling during the autumn of 1925, some promising deposits having been located which will be developed during the winter, and mineral made available for milling operations in the spring. The Bell and Quebec properties in the same district have recently been acquired by Ottawa and Montreal interests, and both of these companies appear to have obtained good financial backing.

Canadian graphite deposits are of good grade. The disseminated flake deposits contain on an average 15 per cent. graphite. The Black Donald deposit is unique, being the richest known deposit in America. It contains over 60 per cent. graphite, and owing to the superior quality of its product it has been able to maintain production during periods of uncertainty. Considerable tonnages are available for increased production.

Canadian graphite is of high quality, suitable for both lubrication and crucible purposes. A high-grade flake can readily be produced by modern methods of concentration and refining. The percentage of No. 1 flake from the disseminated mineral averages about 60 per cent. of the graphite content, No. 2 flake and fines making up the balance of the recovery, which is over 90 per cent. of the content in the mineral. The Canadian industry has suffered in the past by inefficient methods of concentration and refining; by inexperience on the part of promoters; and by importations of cheaply mined flake from Madagascar and Ceylon. The first two factors have been largely eliminated, and graphite can now be produced in Canada at a very reasonable price.

The present activity is due to higher prices for flake in the United States market and to possibilities of increased trade with Europe. Canadian operators have the stability of Canadian credit as an inducement to European trade. The greater development of this trade and the continued support of European buyers will enable Canadian operators to furnish a dependable supply of high quality graphite.

Canadian Magnesite.—The High Commissioner for Canada has received from the Dominion Department of Mines the following information with reference to Canadian magnesite.

Important deposits of magnesite are found in Canada in the Grenville district, province of Quebec. These deposits were worked on a large scale during the war, most of the dead-burned magnesite produced being exported to the United States. After the cessation of hostilities, however, that country placed a heavy import duty on the product, and since then Canadian production has been limited almost entirely to the demands of the home market. At the present time an effort is being made to reduce costs and develop a market in both Great Britain and the United States.

Canadian magnesite contains some lime, against which a prejudice has existed amongst steel manufacturers, but it is being found that such a prejudice is not justified. In the preparation of the Canadian dead-burned magnesite the various grades are so blended as to secure a product of great uniformity, and herein lies one of its chief advantages. Iron in the form of roll scale is mixed with the crude magnesite, which is then finely ground and burned at a very high temperature. The result is a product which gives the fullest satisfaction in the steel trade. A test was carried out recently in an open-hearth furnace which was bottomed with this material. After 200 heats it was found to be in good condition. A chemical and microscopic examination of the bottom showed that nearly all of the lime and silica had recrystallised, forming a monolithic bottom.

Up to the present the chief use for Canadian magnesite has been in the form of dead-burned material for steel furnaces. There is reason to believe, however, that it may also be extensively used in the production of caustic-calcined magnesite for Sorel (oxychloride) cement. The lime which it contains does no harm except when in the free state, and by calcination at a low temperature it is found possible to secure an effective use of the magnesia formed, the calcium carbonate remaining undecomposed and therefore merely acting as a filler. The magnesite is low in iron and the Sorel cement made from it is of excellent appearance and quality.

Magnesite bricks have usually been made of material low in lime, but experiments being carried out at present by the

National Research Council of Canada and the Canadian Department of Mines indicate that, when properly made, lime is not detrimental. When these experiments have been completed the results obtained will be made available to manufacturers of magnesite bricks.

Developments in Selective Flotation.—Great advance has been made recently in the selective flotation of minerals, resulting in better recoveries and higher-grade products from the ores with consequent higher ultimate recoveries at the smelters at lower cost. Progress of this nature is equivalent to the discovery of new deposits and an increase in the world's resources. Surprising results have been described by A. T. Tye from ore of the Capote 15 mine at Cananea, Mexico (*Eng. & Min. Journ.-Press*, 1926, **121**, 597–604). The ore consists principally of pyrite, chalcopyrite, chalcocite, bornite, zincblende, galena, quartz and felspar. The ore contains about 2 per cent. of copper while about 33 per cent. of it is pyrite. Microscopic examination shows that the ore would have to be ground to 400 mesh in order to free the copper minerals from the enclosing pyrite. Before the new methods were introduced the ratio of concentration by gravity and ordinary flotation means was about 2·6 : 1, so that milling 1,500 tons of ore per day the concentrates would have amounted to about 543 tons containing about 4·38 per cent. copper. By August, 1925, the ratio of concentration had been increased to 10·7 : 1 and the concentrates assayed 19·20 per cent. of copper, the quantity to be smelted being reduced to 140 tons per day. The ore is crushed so that rather more than 50 per cent. passes a 200-mesh screen and the circuit is kept alkaline with milk of lime. The following figures illustrate the old and new practice, each for 6 month periods :—

	2nd half 1923.	1st half 1925.
Cost of concentrating, $ per ton	0·83	0·90
Ratio of concentration	2·575	10·18
Copper recovery, per cent.	87·40	91·17
Silver " "	88·21	90·18
Gold " "	95·80	88·82
Copper in ore, per cent.	1·95	1·91
" " concentrate, per cent.	4·38	17·69
Iron in ore, per cent.	16·7	15·7
" " concentrate, per cent.	36·0	30·2
" " tailings, per cent.	5·2	12·1

The reagents used in the old practice were coal-tar, fuel-oil and pine-oil. To-day 0·090 lb. of potassium xanthate and 11·18 lb. of lime per ton of ore treated are employed. The lime has the effect of depressing the pyrite while the copper minerals float. It was found that a mixture of thiocarbanilide and orthotoluidine, known as T-T mixture, was equal in metallurgical effect to xanthate, but the latter is found more suitable for Cananea conditions.

Selective flotation was the subject of an interesting discussion at a recent meeting of the New York section of the American Institute of Mining Engineers, reported in the *Engineering and Mining Journal-Press* (1926, **121**, 542–3). J. M. Callow said that the essential factors in successful selective flotation were: (1) the grinding must be such as to liberate the particles of the various minerals; (2) the proper pulp-density and alkalinity must be attained. Acid circuits are now almost unknown. Reagents may be classified as (1) collecting but non-frothing, of which carbanilide dissolved in orthotoluidine and xanthate are most important. (2) Depressing agents, of which sodium cyanide, zinc sulphate and lime are examples. These prevent zinc, copper and iron sulphides from rising while galena is being floated. (3) Activating agents which revive the temporarily "deadened" sulphides after lead has been floated. Copper sulphate is the principal reagent used for this purpose. (4) Frothing agents such as pine oil, etc. Potassium xanthate is used almost exclusively as a collecting agent for copper ores on account of its ready solubility and cheapness. For lead and zinc ores thiocarbanilide usually gives better recovery and selectivity, thus compensating for its greater cost. During the last eight years important changes of practice have been made at the Utah Apex mill, where the ore treated contains about 9·6 per cent. of lead, 7·2 per cent. of zinc and 15 per cent. of iron. The results are summarised in the following table:—

Method.	Recovery. *Per cent.* Lead.	Zinc.	Lead Concentrate. *Per cent.* Lead.	Zinc.	Zinc Concentrate. *Per cent.* Lead.	Zinc.
Table concentration . .	94	—	18	6·0	—	—
Flotation for lead only .	91	—	53	—	—	—
Selective flotation . .	95	74	52	4·9	0·5	49
Selective flotation with heating of zinc circuit . .	94	88	51	5·7	1·5	52

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON MINERAL RESOURCES.

The following abstracts of the more important recently published papers and reports on mineral resources relate not only to the resources of the Dominions, Colonies and India, but also to those of foreign countries. The Imperial Institute accepts no responsibility for the opinions expressed by the authors of the papers and reports referred to in these abstracts.

METALS.

Aluminium and Bauxite.

Gold Coast.—An illustrated article entitled "Bauxite on the Gold Coast," with a map of the deposits by Lloyd T. Emory, appeared in the *Engineering and Mining Journal-Press* of 13th March (1926, **121**, p. 443).

The ore on Mt. Ejuanema is of both massive and rubbly character, the average thickness being 23 feet. It owes its origin to clay shales, which by natural abstraction of silica have been converted from a hydrated silicate to the hydrated oxide. The average analysis of 17 samples in percentages is as follows: Alumina, 60·55 ; ferric oxide, 9·75 ; silica, 1·42 ; titanic oxide, 2·21 ; lime and magnesia, 0·73 ; water, 25·59. The *Geological Survey* estimates the ore reserves at over four million tons, but development is hindered by cost of transport to the coast. Limestone, which is abundant at Okraji, 20 miles away, could be used with the bauxite for manufacturing aluminous cement.

At Affo Range, near Sefwi Bekwai, 50 miles north-west from Dunkwa, which is 100 miles from the coast, are deposits of bauxite apparently derived by the leaching of silica from phyllites and fine-grained mica-schists on the tops of hills. A small amount of gold is present, which is apparently eluvial and derived from the weathering of quartz veins. The Survey's estimate of the reserves is 22 million tons containing 55·77 per cent. of alumina and less than 1·88 per cent. of silica.

Two mountains, 13 and 15 miles E.N.E. of the Affo group, contain 925,000 and 200,000 tons of bauxite.

Mt. Kawkawti, 18 miles W.N.W., which consists of a basic rock, probably dolerite, has a capping of bauxitic laterite.

Mt. Tiffi, in the Yenahin district, about 35 miles west and a little north of Kumasi, has a capping of ferriferous bauxite amounting to seven million tons.

Canada.—The development of the water power of the Saguenay River, Quebec, in connection with the production of aluminium, is mentioned in the *Times Trade and Engineering Supplement* (May 1, 1926, p. 160). The plans provide for the production by 1927–8 of 180,000 tons of aluminium per year, hence it is probable that soon Canada will be contributing a large proportion of the world's output. It is suggested that aluminium cooking utensils will be produced at the price of " tin pans," and duralumin at a price comparable with that of steel. A refining plant will be built at Chicoutimi, where the deep water on the Saguenay River ends, and most of the bauxite imported from British Guiana will be refined there. According to the *Engineering and Mining Journal-Press* (1926, March 27, p. 535) the institution of a Canadian-Guianan line of steamships is under consideration.

Other industrial developments on the Saguenay River on a huge scale are being considered. Hydro-electric power will be used by the Romanie River Oxide Co., which holds deposits of ochre at Riviere Romanie on the north shore of the St. Lawrence River. This company intends to erect a paint plant at Levis, Quebec, at a cost of $1,000,000.

Russia.—According to the *Metal Bulletin* (1926, Feb. **26**, p. 19) it is reported in *Deutsche Bergwerks Zeitung* that a French industrial group negotiated recently with the Soviet Government as regards a concession for the mining of bauxite in north-west Russia, on the River Voloshba. The deposits are located in the Tcherepovez Government, and were only discovered in recent years. There are reported to be so far discovered 800,000 tons of first quality bauxite and over a million tons of lower grade.

United States.—In a *Bulletin* (No. 750G) of the *United States Geological Survey*, 1925, by E. F. Burchard, entitled "Bauxite in N.E. Mississippi," are described deposits of bauxite, mostly low grade, which extend over 10 counties in the area mentioned and are estimated to contain $1\frac{1}{2}$ million tons. The geology of the deposits is described, and a large number of analyses are given.

Gold.

Russia.—The *Soviet Union Monthly* (1926, **1**, March, p. 31) gives the following list of gold-bearing areas in which concessions are obtainable: (1) the Berezovsky region of the Urals, 8 miles from a railway and near Sverdlovsk, where there has been an output of about 260,000 oz. of gold per year; (2) the Kotchkarov region of the Urals; (3) the Bogomdarovanny, a rich mine in the southern part of the Atchinsk district, province of Eniseisk, and (4) another rich mine in the Undinsk region. All the above are stated to have been prospected and to be ready for operation. Unprospected areas include: (1) the Tubinsk deposits near the town of Minusinsk; (2) the Limurinsk deposits of the Amur, and (3) those of Chukotisk Peninsula. Concessions for gold mining have recently been given to Lena Goldfields Ltd., to the Ayan Corporation, and to the Japanese Mining Company, Tanaka.

Nickel.

Recent developments in the nickel industry were described by P. D. Merica at the March meeting of the *Canadian Institution of Mining and Metallurgy*, and are reported in *Canadian Mining Journal* (1926, **47**, 329–336 and 396–400). The reduced demand for nickel in armaments since the war has been nearly compensated for by the creation of new uses, with the result that the industry is now on a far firmer foundation than previously. The increased willingness in the engineering trades to consider the use of alloy steels in place of materials used hitherto has been of marked assistance, while the growth of the motor industry has called for largely increased quantities of special alloys of all kinds. It is estimated that about $1\frac{3}{4}$ lb.

of nickel are used in each motor-car produced, chiefly in the form of nickel-steel for gears, axles, crank-shafts, etc. Turbine reduction-gear forgings, turbine rotors and hydraulic-press columns are among the more important new uses of nickel-steel. Monel metal is replacing other materials in laundry machines and dyeing vats, owing to its resistance to corrosion and the ease with which it can be cleaned. Great improvements have been made in monel metal itself, and in methods of treating it so that it can now be fabricated with ease, i.e. can be welded, machined, brazed, drawn and stamped. Many other important alloys have been developed with greatly varied uses. The present price of nickel is less than that ruling before the war. The world's consumption of nickel in 1925 is estimated at 30,000 tons, of which the United States took more than half.

Platinum.

Southern Rhodesia.—A Short Report (No. 19), entitled "Platinum in Southern Rhodesia," by B. Lightfoot, has recently been issued by the *Southern Rhodesia Geological Survey*. The author summarises the matter which had been previously published, including an article written by H. B. Maufe, Director of the Geological Survey, who drew special attention to the necessity for prospecting the following Great Dyke areas in which norite was known: (1) the section southwards from Makwiro to possibly beyond the Umfuli River; (2) the Selundi Hills section, east of Selukwe; (3) the north-west corner of the Belingwe district on the Springs, Bannockburn and Sandeman's farms. Platinum has since been found in all these areas, which are shown in the Report on a sketch map. A series of rock specimens from the neighbourhood of Makwiro proved to be very similar in appearance to the Upper or Merensky Reef in the Lydenburg district of the Transvaal, and, after an examination of the neighbourhood from which these specimens were obtained, it was decided that the author should make a geological map of the Great Dyke between the Hunyani and Umfuli rivers, which covers an area of some 450 sq. miles. The structure of the Great Dyke, a knowledge of which is important in connection with future developments of platinum and chrome ores, still remains unsettled by the author's somewhat limited investigations.

The area examined includes a body of norite 28 miles long and up to 5½ miles broad. The Great Dyke itself is chiefly bounded by granite, but near the Umfuli River to the south are small areas of basement schists with banded ironstone. The rock groups in order of age are: (5) soil, (4) basalt dykes, (3) norite, pyroxenite and harzburgite of the Great Dyke, (2) granite, (1) banded ironstone and greenstone schist.

In a plan of the dyke in the Makwiro area is shown the capping of felspar-rich norite which rests on a thick layer of pyroxenite. This, in turn, is underlain by a thinner layer of serpentine with chrome seams, which dies out to the south. The bottom or marginal layers of the dyke are poorly exposed and rotten, and appear to be mainly of harzburgite. The rocks of the dyke in the Makwiro district appear to be a series of beds of synclinal form, the norite forming the central portion of the dyke in all platiniferous areas. The platinum-bearing zone, a pyroxene-rich norite reef, occurs a few feet below the base of the norite proper, its outcrop being often concealed by boulders resulting from the decomposition of the norite. Its platinum content ranges from a trace to 3 dwt. per ton. The author is convinced of its exact similarity to the Lydenburg reef. An enormous tonnage of ore is present, but whether such low-grade material can be profitably exploited remains to be determined.

A platiniferous area 2 miles long has been recently pegged in the Tebakwee district of Southern Rhodesia. Some samples are reported to have averaged 4·6 dwt. crude platinum per ton over a width of 46 in. The lowest assay was 3·1 dwt. over 48 in.; the highest 8 dwt. over 36 in. The strike is very regular and it is thought possible that the lode may extend to a considerable depth. It occurs in pyroxene-norite, which underlies spotted norite (anorthosite) and overlies enstatite. The lode is very flat, and dips to the west (*Min. Journ.* 1926, **152**, March 20, p. 237).

New Zealand.—The *New Zealand Official Year Book* (1926, p 9) gives an account of various occurrences of platinum in the Dominion. In Southland crude platinum is found in gold wash, and is distributed for a distance of 92 miles along beaches and coastal terraces from Blue Cliffs to Longbeach. The platiniferous sands are derived from serpentine or other olivine-bearing rocks which occur in Fiordland. Native platinum has been obtained in payable quantities from Cameron Creek, Groveburn, Orepuki, Pahi, Round Hill, Steel Head, Bushy Point, Waipapa, Otara Beach, 12-mile Beach, and Waikawa. The coarsest platinum is found west of Waiau River, while that won east of Otara is very fine. From the gold alluvial workings at Waikoau River, Rowallen, as much as 1 oz. of platinum has been obtained to every 3 oz. of gold. The platinum is left as a residue after the amalgamation of the gold, and by further washing a 50 per cent. concentrate is obtained. Assays of two samples of concentrate from Smith's Claim, Round Hill, gave: (1) gold 53 oz. and platinum 72 oz. per ton of concentrate; (2) gold 15 oz. and platinum 51½ oz. Concentrates from the rich wash on the Otara Claim assayed: osmiridium 15¼ dwt.; platinum, 7½ dwt.; gold, 5 dwt. per ton.

Tin.

Hong Kong.—A description of Hong Kong tin-refining methods has been given by P. R. Wolff in the *Far Eastern Review* and is abstracted in *Eng. and Min. Journ.-Press* (1925, **121**, 407).

Although there is one fairly modern smelting plant at Kochiu in Yunnan, where most of the Chinese output of tin is obtained, the product is low-grade, ranging from 50 to 90 per cent. of tin. Most of it is sent, therefore, to be refined at one or other of the six refineries in Hong Kong. The slab tin to be refined is melted in a circular iron pan, 39 in. in diameter and 12½ in. deep, in the centre of which is placed an iron cylinder 15 in. in diameter, 12 in. high and $\frac{5}{16}$ in. thick. The contact between the pan and cylinder is a knife-edge past which the tin as it melts finds its way into the cylinder, whence it is ladled into moulds. The slag on the metal outside the cylinder is skimmed off at frequent intervals. It contains about 70 per cent. of tin and is reserved for refining with charcoal under forced draft during slack periods. The residue from this further operation, called "iron tailings," contains from 30 to 35 per cent. of tin and is exported to Europe or North China. The control of all operations is entirely by observation, chiefly of the surface of test-discs drawn from the cylinder. Should the metal be too impure for the grade required it is "sweetened" by the addition of Straits, Banca or Ho Yuen (Kwangsi) tin. The latter contains 99·8 or more per cent. of tin. Each refinery has a capacity of about 25 tons per working day of 16 hours. Seven grades of refined tin are exported as follows :—

No. 1.	Minimum	99 per cent. tin	To foreign countries, chiefly United States.
,, 2.	,,	98 ,, ,,	
,, 3.	,,	96 ,, ,,	
Kap slabs		99·5 ,, ,,	To Swatow.
Dow ingots		99·5 ,, ,,	
Dow slabs		98 ,, ,,	To Amoy and Foochow.

Kwa Hung No. 3 pigs, slightly under 98 per cent. tin, to Shanghai and North China.

Bolivia.—The geologic features of Bolivia's tin-bearing veins is the subject of an article by F. R. Koeberlin in *Eng. and Min. Journ.-Press* (1926, **121**, 636–642). The secondary enrichment of tin veins in Bolivia has been generally attributed, hitherto, to the oxidation and solution of stannite with re-deposition of the tin as cassiterite. Koeberlin maintains that in many important cases the primary cassiterite has been dissolved and reprecipitated in lower parts of the veins to form zones of secondary enrichment. The belt in which the Bolivian tin veins occur is about 600 km. by 100 km., the northern half of this zone being characterised by granite out-crops while in the southern half the outcrops consist of rhyolite-

porphyry. The veins graduate from normal tin veins in the north through tin-silver, silver-tin and silver veins to lead-zinc veins in the south. The principal veins occupy fault-fissures, the movement in some cases being very considerable, as for example the San Fermin vein at Llallagua where the displacement amounts to about 500 m. Other veins are contraction fissures. The author gives a number of instances of secondary enrichment on which is based a classification of the veins on economic lines, as follows :—

(1) Veins, the primary filling of which is too low-grade to be profitably worked, but which in the upper portions have been brought within the economic limit by secondary enrichment processes. Examples: the great majority of small displacement mines worked in Bolivia.

(2) Veins, the primary filling of which is in itself exploitable with profit, but which have furthermore shown a secondary enrichment zone of exceptionally high values. Examples: Llallagua-Uncia, Potosi, Oruro.

(3) Veins, the primary filling of which alone is the basis of exploitation, and which have not been secondarily enriched. Example: Chocaya (Colorada tin vein).

Koeberlin considers that Bolivia has great possibilities in regard to the discovery of new tin deposits, for which electrical prospecting methods would probably be useful, especially in southern Bolivia, where many veins carry a high proportion of pyrite.

Titanium.

Canada.—According to *Can. Off. Min. News Letter* No. 78, Feb. 1926, received from the High Commissioner for Canada, research is being conducted by the Mines Branch, Canada, and by a firm of pigment manufacturers, on the possibility of producing electrolytic iron and titanium white pigment from Canadian ilmenite. The ore is mixed with carbon and reduced in a rotary kiln to sponge iron, the titanium oxide remaining unaltered. The iron is then dissolved out with ferric chloride and the resulting ferrous chloride solution is electrolysed, iron being deposited and ferric chloride remaining, which can be used over again. The titanium oxide residue is treated with sulphuric acid and evaporated down. The sulphate mass is then leached with water, which results in the precipitation of metatitanic acid. This is mixed with *blanc fixe* and calcined at a high temperature into marketable pigments.

For the success of this process cheap electrical energy is essential, and as this is available in Quebec close to the ilmenite deposits, and as the results of experiments have so far been satisfactory, the possibility of utilising Canadian ilmenite in this way seems very promising.

Zinc.

In the process of galvanisation, the importance of the purity of the metal galvanised as well as that of the zinc itself is not generally recognised. It is well known that pure zinc is very resistant to the action of air and water and therefore does not corrode easily. Molten zinc readily dissolves impure iron with the result that the purity of the zinc-coating depends upon the purity of the metal dipped in the galvanising bath. For example, steel dissolves in zinc several times more rapidly than ingot iron, which corresponds closely with their respective impurities, ingot iron having only one-fifth of the impurities in ordinary steel. Further, a dense uniformly rolled sheet dissolves less rapidly than an irregular sheet. The effect of variation in the under-material on the coating itself is shown by the following figures :—

Material galvanised.	*Per cent.* of iron in zinc coating.
Ingot iron	3·92
Coppered iron	4·89
Common steel	5·91
Coppered steel	4·55

The life of a galvanised sheet, then, depends directly on the purity of the iron or steel used in it, as the points at which impurities occur in the coating form poles for electrolytic action in the presence of air and moisture (*Chem. and Ind.*, 1926, **45**, 139).

French Indo-China.—*The Compagnie Minière et Métallurgique de l'Indo Chine,* operating a zinc smelter at Quang-Yen, has now issued its report of a first year's work According to the *Echo des Mines et de la Métallurgie* (1926, 1st April, 152–5), the plant commenced operations in November 1924, and produced 1,141 tons of zinc. The ore despatched from the mines to the smelter amounted to nearly 3,000 tons. Two new furnaces are under construction and four others are proposed for 1927, when the total production of the plant is estimated to reach about 8,000 tons of zinc, while the ore required will be about 20,000 tons.

NON-METALS.

Asbestos.

Union of S. Africa.—In a recently published report on " The Economic Geology of Sabie and Pilgrims Rest " (*Mem. No.* 23, *Geol. Surv., Union of S. Africa*), by W. J. Wybergh, an account is given of an occurrence of asbestos on the farm Oliphantsgeraamte No. 459. The occurrence is situated on the west side of a spur east of the old main road from Sabie to Lydenburg.

The outcrop, which has been traced for about a mile, runs along the top of a kranz which marks the course of a flat, intrusive igneous sheet about 50 feet thick, and appears to be about 200 feet below the bottom of the Pretoria shales. The dolomite in contact with the upper surface of this has been altered to serpentine, and is somewhat crushed and contorted. The thickness of visibly altered dolomite exposed is about 3 feet, consisting of alternate hard and soft bands well brought out by the weathering. Where unweathered, it is a hard, compact, fine-grained yellowish-grey rock, interleaved with light greenish serpentine. The asbestos-bearing bed is about 18 in. thick, and consists of dark serpentine mottled with green, containing asbestos bands scattered irregularly through it. The latter forms from one-third to half of the mass, but the proportion varies. Individual bands are very irregular, but there are usually one or more bands up to 1⅛ in. thick, and several more from ¼ in. to ½ in. Beneath this is a bed, 2½ feet in thickness, of hard, serpentinised dolomite, sometimes veined or mixed with irregular bands of fine-grained crystalline marble. This may be up to 4 feet in thickness, and sometimes carries another seam of asbestos 3 feet below the main seam, with 12 in. of serpentine immediately beneath it, resting on the igneous sheet. The commercial qualities of this asbestos have not yet been investigated, but at the outcrop the fibre appears to be somewhat brittle.

Canada.—It is reported that the asbestos found at Lytton, B.C. (mentioned in the last number of this BULLETIN) has proved to be of the amphibole variety and is therefore of little commercial interest. (*Asbestos*, 1926, **7**, Feb., p. 12.)

Basalt.

France.—A firm with works at Vitry-sur-Seine and at Le Puy has developed a thermic process by which basalt may be fused and moulded into any desired shape. The fused basalt has a tensile strength of 42,000 lb. per square in., a dielectric strength of 35,000 volts per ¼ in. thickness, and is extremely resistant to the action of acids and caustic alkalis. It may be made into tanks or vats, lining slabs, pipes, taps, and other appliances utilised in the chemical industries. (*Chem. Trade Journ.*, 1926, **78**, 318.)

Clays.

Union of S. Africa.—In a recently published report on "The Economic Geology of Sabie and Pilgrims Rest" (*Mem. No.* 23, *Geol. Surv., Union of S. Africa*), by W. J. Wybergh, an account

is given of a deposit of kaolin on the farm Bultfontein No. 248, which lies south-east of Sabie on the granite below the Berg and about 10 miles north of White River Settlement. A considerable amount of prospecting has been done at this locality. The main deposit is situated between two spruits just above their junction near the south-eastern end of the farm, but the material extends to both sides of these spruits, the exact extent not being ascertainable on account of the overburden of soil, etc. The kaolin has evidently been derived from the granite, but the actual deposit has obviously been laid down by running water. It consists of remarkably pure white kaolin, in some cases entirely free from quartz or other sand, in others more or less mixed and requiring further washing. The whole deposit, where opened up, lies beneath an overburden of from 4 feet to 5 feet of surface soil, and consists of alternating beds of pure white kaolin, with more or less sandy kaolin, pure light-yellow kaolin, brown clayey sand, and brown gravel. The division between the various beds is usually fairly sharply defined, and there should be no difficulty in working the pure kaolin separately from the sandy kaolin. The former is stated to have been analysed and found to be of the highest grade, and it certainly has that appearance. The bulk of the deposit, as far as can be seen, is contained in an area of about 2,000 feet by 700 feet, and the quantity is probably very large. It is not improbable that other similar deposits exist in the neighbourhood.

United States.—In *Eng. and Min. Journ.-Press* (1926, **121**, 408), there appeared an article by V. M. Arciniega on clay deposits in Nevada which are being worked on account of their oil-bleaching properties. The deposits, which consist of a series of lake beds of Tertiary age ranging in thickness from a few inches to several feet, are situated in Nye county, Nevada, and 10 miles north-east of Death Valley Junction. These clays are mixtures of hydrous silicates of alumina and magnesia, the latter predominating, and physically they resemble the montmorillonite or bentonite of Otay River valley, California. Both varieties occur in bedded deposits, lenses and balls in a white, fine-grained limestone. They are being worked in open pits, the clay being air-dried to a 20 per cent. moisture content. It has been found that for filtering oils the aluminous clay is from ½ to 1½ times as effective as fuller's earth, and the magnesian from 2 to 4 times as effective as that substance. No acid treatment is employed to render the clays active. Each batch is tested and graded according to its filtering efficiency before being put on the market. At present, 1,000 tons per month are produced and considerable reserves are available.

Coal.

Nyasaland.—The Sumbu coal area of Lower Shire, Nyasaland, is described by F. Dixey, Government Geologist, in the *Mining Magazine* for March (1926, **34**, 148).

The mineral survey of Nyasaland was begun in 1906 and carried on for some years by A. R. Andrew and T. E. G. Bailey under the direction of the Imperial Institute, and later in 1920 by R. M. Craig as Government Geologist, who was followed by the author in 1923. The Imperial Institute has examined a large number of samples of coal from time to time.

The Sumbu district, which is in the extreme south of Nyasaland, is covered by rocks of Karroo age, which extend west to the Zambesi River and are known to contain seams of coal. Their area in Nyasaland is 800 sq. miles; they are bounded on the east by the Shire River and on the west by the Anglo-Portuguese border. The latitudes of Chikwawa and Port Herald bound them on the north and south. Andrew and Bailey, in their geological map, published in 1910, distinguish the following five groups of rocks, beginning with the uppermost, and proceeding roughly south-west to north-east: (5) Lava; (4) Upper Sandstone; (3) Shale; (2) Lower Sandstone; (1) Boulder Beds. The Shale Group, No. 3, consists of sandstones, black and grey shales and mudstones, with seams of coal and ironstone. *Glossopteris* is found in the shales. The group crops out only in two places: at Chiromoto, where the Government is boring for coal with encouraging results, and at Sumbu, which is the more important section, and is bounded by the Nkombedzi wa Fodya River and the Anglo-Portuguese border, being 20 miles long from north-west to south-east and of 10 miles maximum width. The beds dip gently to the south-west and do not reappear in British territory. Owing to their inferior resistance to weathering the rocks of the coal area exist as a broad depression between two sandstone uplands. Andrew and Bailey examined a number of beds exposed near the rivers, but only coaly shale of low fuel value was found. Craig, continuing the investigation, amongst others found a 7 feet seam of coal 4 miles west of Chundisa, the calorific value being 6,728 B.Th.U. The author resurveyed the area in 1923–24 and sampled 13 additional outcrops, all close to the Nkombedzi and its tributaries; the seams, from 3 feet 6 in. to 12 feet thick, were much weathered; some were explored by shafts, others by adits. The coals greatly improved in depth; three of them, coking coals with better flaming qualities, yielded promising results upon analysis, the best of which was: fixed carbon, 51·44; volatile matter, 24·86; ash, 18·97; moisture, 4·79; and sulphur, 0·59 per cent. The calorific value was 10,214 B.Th.U. From distillation experiments made on the coals, at the Imperial Institute it was found that up to 97 lb.

of ammonium sulphate per ton could be obtained. This chemical would find a ready sale in Nyasaland as a fertiliser, but for its preparation either the local production, or the importation, of sulphuric acid would be necessary. The ash of the Sumbu coals is an infusible powder forming no clinker on the firebars of furnaces.

The continued examination of the area having yielded increasingly better results, further testing by systematic boring is recommended.

Union of South Africa.—In the *South African Mining and Engineering Journal* (1926, March 20, p. 55) are described the coal deposits in the Klip River valley in the Transvaal. The field extends from the boundary of the farm Zuurbekom, which is between Potchefstroom and Johannesburg, a considerable distance west down the Wonderfontein Valley and south to the foot of the Gats Rand.

The coal so far disclosed by boring is of quality equal to that of Vereeniging or Coalbrook, having low sulphur and ash contents. The area of marketable coal is estimated at 1,000 acres. There is a main shaft sunk on the farm Cyferfontein, which adjoins Zuurbekom. One estimate of coal reserves is 6 million tons, with a total thickness of seams of 70 feet. Another estimate gives 11 million tons with a total thickness of 141½ feet. The main shaft is 2½ miles from Lenz station, which is 18 miles from Johannesburg.

Canada.—According to a *Canadian Official Mining News Letter* received from the High Commissioner for Canada in London (April 15, 1926), the existence of large deposits of high-grade lignite has been established in the Copsey mine, which is 45 miles south of Moose Jaw, Ardill district, Saskatchewan, and which has been developed for several years. It has been estimated that the deposits will yield approximately 4,000 tons of fuel per acre and the possible productive area will be at least several square miles. The main seam is over 4 feet thick, is at a depth of only 80 feet and can be mined cheaply.

India.—The *Colliery Guardian* (1926, **31**, Feb. 19, p. 436) published extracts from the new Coal Grading Bill on the grading of Indian coal giving the standardisation proposed by the Coal Grading Board. Coals are to be classified as follows :—(A) *Low Volatile Coals*, including those of Jherria, Giridih, Karanpura and Bokara; (B) *High Volatile Coals*, including those of Raniganj and Karanpura.

Four grades of coal are specified :—

	Class.	Ash *per cent.* (maximum).	Moisture *per cent.* (maximum).	Calorific value calories (minimum).
Selected . .	A	13	—	7,000
	B	11	6	6,800
Grade I . .	A	15	—	6,500
	B	13	8	6,300
Grade II . .	A	18	—	6,000
	B	16	10	6,000
Grade III .	Any coals in the coalfields mentioned, inferior to the above.			

China.—In an article entitled "Coal in China" (*Econ. Geol.*, 1924, **19**, 641), G. D. Hubbard makes a preliminary report on some coals from Szechuan. In this region, which is that of the Red Basin, are a considerable number of anticlinal folds along each of which coal occurs, the seams varying from 3 to 6 feet in thickness. The coals tested included 2 cannel, 3 sub-anthracitic and 12 bituminous. In five samples the calorific value varied from 12,707 to 19,072 B.Th.U., and the ash from 7·56 to 35·33 per cent.

Dolomite.

Russia.—New deposits of dolomite of good quality, estimated to contain about one million tons, are reported to have been found near Izvara (on the Volosovo-Minsk railway) and not far from Leningrad. The demands of all the works in the neighbourhood can be supplied from these deposits. (*Soviet Union Monthly*, 1926, April, p. 65.)

Gypsum.

Canada.—The *Eng. and Min. Journ.-Press*, (**121**, 379), contains the report that a large deposit of exceptionally high-grade gypsum has been located in northern Ontario, 140 miles north of Cochrane. A firm in Montreal has offered to contract for large quantities of this mineral daily, and is urging the Ontario Government to extend the railway to reach the deposit.

Helium.

Canada.—In the township of Caledon, Peel county, Ontario, there are three wells producing natural gas which contains helium in sufficient quantity to warrant extraction. The helium content is 0·8 per cent., and the gas has been found in the Dundas (Lorraine) shales at a depth of 400 to 600 feet over a widespread area. (*Can. Off. Min. News Letter No.* 81, High Commissioner for Canada, March, 1926).

Petroleum and Allied Products.

Canada.—The important developments in regard to oil and gas that have taken place during recent years in Alberta have been summarised in this BULLETIN (1925, **23**, 379–380). A preliminary report by G. S. Hume on his work in Eastern Alberta and Western Saskatchewan is now obtainable from the *Natural Resources and Industrial Information Bureau,* The Canadian Building, Trafalgar Square, S.W.1. In 1924, a reconnaissance study was made of an area east of the Wainwright field. In 1925, a detailed examination was made of the area in the vicinity of Battle River, between range 24 west of the 3rd meridian and range 3 west of the 4th meridian. A further reconnaissance survey was made extending over an area in Saskatchewan, between latitude 52° and the North Saskatchewan River and longitude 108° and the 4th meridian. Detailed information is given bearing on the interpretation of the structural features of the area, such as would be of value to any company planning a drilling campaign. A broad anticline with very low dips, called the Ribstone-Blackfoot anticline, was mapped on Battle River, near the Alberta-Saskatchewan boundary. The crest of this minor fold coincides with that of a much broader regional fold. The chances for the occurrence of oil in this structure are discussed, and suggestions are made as to the location of test wells.

British Guiana.—The fact that pitch has been found on the coast of British Guiana from time to time has led to considerable speculation as to the possibility of petroleum being found in the North-West and Pomeroon districts. It has been thought by some that the oil-bearing Tertiary strata of Trinidad, Barbados and northern Venezuela might also occur in these districts. The results of investigations made by the late Director of Science and Agriculture and by two geologists acting for an important oil company are now summarised in a *Combined Court Paper* (1925, No. 37). Briefly, it shows that the area concerned is largely covered by recent alluvium underlain by the basal igneous complex. Where sedimentaries are visible, they are without impermeable cap-rocks. It is possible that other sedimentary strata occur between the alluvium and basal rocks, but there is no proof that they do so or that they would be petroliferous if existent. The conclusion reached is that it is improbable that petroleum can be obtained in British Guiana in commercial quantities.

Australia.—According to the Melbourne correspondent of the *Petroleum Times* (1926, **15**, 721) the Commonwealth Parliament has appropriated £60,000 to assist persons or companies to search for oil, and State Governments to make geological surveys. The Freney Kimberley Oil Company has

been granted £22,500 on a £1 for £1 basis and is about to commence boring at Poole Range, 200 miles from Derby, W.A. The Hunter River Oil Company has received a similar subsidy and is preparing to work on the Belford Dome, near Maitland, N.S.W., on lines laid down by Arthur Wade.

Salt.

Canada.—The refining plant of the Alberta Salt Company commenced operations in the middle of 1925, with a capacity of 25 tons per day. The plant is at the junction of Horse Creek and the Athabasca River. Two beds of rock-salt are being worked by circulation of water and pumping of brine. One bed occurs at a depth of 590 feet and is 100 feet thick, while the other occurs at 765 feet and is 90 feet thick. (*Oil, Paint, and Drug Reporter*, 1926, **109**, No. 21, p. 62.)

Sulphur.

China.—The most important centre of sulphur-mining in China is Wangfengshan in the Taiyuan district of Shansi Province. The industry is a monopoly controlled by a government bureau, which regulates the sale and transport of sulphur and frequently suspends the operations of mining companies. The annual output in Taiyuan before 1921, when the bureau was formed, was about one million catties (670 tons), but has been declining since. The sulphur ore occurs interbedded in sandstone and is easily separated. It is melted out in fireclay funnels surrounded by coal fires, and collected in jars. A large part of the sulphur is consumed in the Government Arsenal at Tehchow in Shantung Province, and the balance is sold chiefly for making fireworks. The price of sulphur on the Shansi local market has risen from about $5 per catty, in 1917, to about $10 at present. The tax has been raised from 18 cash to $0·08 per catty. Iron-pyrites is produced in many places in Shansi and is controlled also by the above-named Bureau. (*Chemical Trade Journ. and Chem. Engineer*, 1926, **78**, 359: Extracted from *Chinese Economic Bulletin*).

Uranium (Radium) Minerals.

France.—According to *The Chemical Age*, April 3rd, 1926, p. 344, there are two French firms producing radium, Armet de l'Ile at Nogent and Henri de Rothschild at St. Denis. They are treating betafite and other Madagascan minerals, but as these are more difficult to extract than are the Katanga uranium minerals, the French industry is facing a crisis.

Belgium.—The same article states that the Belgian Hoboken Society has produced 50 grams of radium from Katanga ore in the past three years.

BIBLIOGRAPHY.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, March–May, 1926.

The publications issued by the Governments of the Crown Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion Government publications may be made to the Offices of the High Commissioners or Agents General in London.

General.

The Geology of Berwick-on-Tweed, Norham and Scremerston. By A. Fowler. *Memoirs Geol. Surv. England, New Series, Sheets* 1 *and* 2. Pp. 58 + ix. (London: H.M. Stationery Office, 1926.) Price 1*s.* 6*d.* Net.

Report on the Trade and Commerce of East Africa (Uganda Protectorate, Kenya Colony and Protectorate, Zanzibar and the Tanganyika Territory). By C. Kemp, with a foreword by W. H. Franklin. Dept. Overseas Trade Report to September, 1925. Pp. 48, $9\frac{1}{2} \times 6$. (London: H.M. Stationery Office, 1926.) Price 1*s.* 6*d.* Net.

Report on the Mines Department, Government of the Gold Coast, for the period April 1924–March 1925. Pp. 38 and plans. (Accra: Government Printing Department, 1925.)

The Year Book and Directory of the South African Mining and Engineering Journal, 1926 edition. Pp. 366 Price 10*s.* 6*d.*

Notes on the Mineral Production of the Union and their Relation both Geographically and Geologically. Anniversary Address by the President, W. G. Holford. *Proc. Geol. Soc. S. Africa* (to accompany Vol. 28 of the Transactions, January–December, 1925, pp. xix–xxx).

Rock and Air Temperatures in Deep-Level Mines. By M. O. Tillard and E. C. Ranson. *Journ. Chem. Met. Min. Soc. S. Africa* (1926, **26**, 184–208 with discussion).

Economic Minerals of Canada. By W. Malcolm. No. 2062, Geol. Survey Canada, British Empire Exhibition Edition. Pp. 28, $6\frac{1}{2} \times 4\frac{1}{2}$. (Ottawa: Government Printing Bureau, 1925.)

65th Annual Report of the Department of Lands and Mines of the Province of New Brunswick for the Year ended 31st October, 1925. Pp. 74, $9\frac{1}{2} \times 6\frac{1}{2}$. (Fredericton, N.B., 1926.)

Pegmatite Dikes of South-eastern Ontario. By F. L. Sine. *Can. Min. Journ.* (1926, **47**, 169–171, 237–243, 257–262.)

Report of the Chief Inspector of Mines in Mysore for the Year 1924–5. Pp. 49 and Appendices. (Bangalore: Government Press, 1925.)

Annual Report of the Department of Mines, Western Australia, 1924. Pp. 87, 13×8. (Perth: Government Printer, 1925.)

Beobachtungen über Blei-, Zink-und Kobalterze im Gebiet von Mechernich (Eifel). By F. Behrend. *Zeits. f. prakt. Geologie* (1925, **33**, 185–193).

Rivista del Servizio Minerario nel 1924, Ministero dell' Economia Nazionale. Pp. 311, 10×7. (Rome: Provveditorato Generale dello Stato, 1925.) Price L.40.

Die Entwicklung des sowjetrussischen Berg- und Hüttenwesens. By E. Kulschewski. *Montan. Runds.* (1926, **18**, 10–12.)

Report on the Economic Conditions in Cuba, dated November, 1925. By M. H. C. Kelham. Dept. Overseas Trade. Pp. 22, $9\frac{1}{2} \times 6$. (London: H.M. Stationery Office, 1926.) Price 1*s.* Net.

La Riqueza Minera de Mexico en 1924. By J. A. García. *Bol. Minero.* (1925, **20**, 201–226).

The Mexican Situation. An Unprejudiced Picture of Conditions as they affect Mining. By A. B. Parsons. *Eng. Min. Journ.-Press* (1926, **121**, 277–287).

Report on the Finance, Industry and Commerce of the United States of America. By J. Joyce Broderick. Dept. Overseas Trade Report, dated September–October, 1925. Pp. 123, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 3*s*. 6*d*. Net.

Geology of a Part of Western Texas and South-Eastern New Mexico, with Special Reference to Salt and Potash. By H. W. Hoots. Bull. 780–B. *U.S. Geol. Survey*. Pp. 33–126, 9 × 6. (Washington: Government Printing Office, 1925.)

Cutting Mining Costs in the South-West. By C. A. Mitke. *Eng. Min. Journ.-Press* (1926, **121**, 681–683).

Report on the Financial, Commercial and Economic Conditions of the Argentine Republic. By H. O. Chalkley. Dept Overseas Trade Report, September, 1925. Pp. 90, 9½ × 6. (London: H.M Stationery Office, 1925.) Price 2*s* 6*d*. Net.

Report on the Finance, Trade and Production of Bolivia, dated October, 1925. By A. J. Hill. Dept. Overseas Trade, Pp. 17, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 6*d*. Net.

Report on the Economic and Financial Conditions in Brazil. By E. Hambloch. Dept Overseas Trade Report dated September, 1925. Pp. 70, 9½ × 6. (London: H.M. Stationery Office, 1925.) Price 2*s*. Net

Report on the Industrial and Economic Situation in Chile. By W. F. Vaughan Scott. Dept Overseas Trade Report dated September, 1925. Pp. 93, 9½ × 6. (London: H M Stationery Office, 1926.) Price 2*s*. 6*d*. Net.

Peru: A Commercial and Industrial Handbook. By W. E. Dunn. *U.S. Dept. Commerce, Trade Promotion Series, No.* 25. Pp. 530. (Washington: Government Printing Office, 1925.) Price $1.25.

Report on the Financial and Economic Conditions in Uruguay, dated November, 1925. By H. W. Reid Brown. Dept. Overseas Trade. Pp. 18, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 9*d*. Net.

Ueber nutzbare Lagerstätten in Afganistan. By O. Herbordt. *Zeits. f. prakt. Geologie* (1925, **33**, 193–198).

Report on the Commercial and Economic Situation of the Philippine Islands. By T. Harrington. Dept. Overseas Trade Report to June, 1925. Pp. 26, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 9*d*. Net.

Die Bodenschätze Sibiriens und ihre wirtschaftliche Bedeutung. By W A. Obrutschew. *Internat Bergwirts* (1926, **1**, 127–131).

Die Entwicklung von Niederländisch-Ost-Indien als Bergbauland. By L. Rutten. *Internat. Bergwirts.* (1925, **1**, 5–9, 78–83).

Systematic Application of Geophysical Methods of Prospecting. By R. Ambronn. *Petr. World.* (1926, **23**, 125–128, 130).

Analysis of Copper-Palladium-Gold-Silver Concentrates. By C. W. Davis. *U.S. Bur. Mines, Repts. of Investigations*, Ser. No. 2731. Pp. 5. (Washington: Bureau of Mines, 1926.)

Das "Elbof"–Verfahren für geoelektrische Untersuchungen. Entgegnung auf den Aufsatz Karl Sundbergs. By N. Gella. *Montan. Runds.* (1926, **18**, 299–302).

A Proposed Mining Method. Inclined Top Slicing with Scraping in Wide Veins. By G. T. Harley. *Eng. Min. Journ.-Press* (1926, **121**, 158–163).

Magnetometric Surveying as an Aid in Exploring Placer Ground. By K. C. Laylander. *Eng. Min. Journ.-Press* (1926, **121**, 325–328).

Portable Gas-driven Mining Plants. By F. A. McLean. *Bull. Can. Inst. Min. Met.* (1926, No. 165, pp. 73–94).

Underground Blasting in Metal Mines with Liquid Oxygen Explosives. By G. St. J. Perrott. *Eng. Min. Journ.-Press* (1926, **121**, 357–365).

METALS.

Alloys.

Sand-cast Aluminium-Manganese Alloys. By S. Daniels. *Ind. Eng. Chem.* (1926, **18**, 125–130).

Les Transformations de certains Alliages d'Aluminium et l'Influence des Déformations. By L. Guillet. *Rev. de Mét.* (1926, **23**, 48–52).

The Die Casting of Aluminium Alloys. By G. Mortimer. Paper read before Institute of Metals March 10, 1926. Abstr in *Metal Ind.* (1926, **28**, 247–249, et seq.)

Aluminium and Bauxite.

Mining Cryolite in Greenland. By S. G. Gordon *Eng. Min. Journ.-Press* (1926, **121**, 236–240).

The High Price of Aluminium. By R. J. Anderson. *Min. Journ.* (1925, **152**, 92–93, 124–125).

The Outlook for Aluminium. By R. J. Anderson. *Mining Mag.* (1926, **34**, 137–147).

Antimony.

Antimony in Bolivia. By L. Voge. *Eng. Min. Journ.-Press* (1926, **121**, 677–680).

Chinese Antimony Trade in 1925. Abstr. in *Min. Journ.* (1926, **153**, 289).

Chromium.

A General Survey of Chromium Plating. By E A. Ollard. Presented to Electroplaters' and Depositors' Techn. Soc. Abstr. in *Metal Ind.* (1926, **28**, 153–155).

Progress in the Chromium and Chromium-Nickel Corrosion Resisting Steels Industry. By W. H. Hatfield. *Indus. Chem.* (1926, **2**, 11–12).

Cobalt.

The Matabitchuan Area (Districts of Timiskaming and Nipissing). By E. W. Todd. *Ann. Rept. Ontario Dept. Mines* (1925, **34**, Part 3, 1–35 and maps).

Copper.

Die Kupfererzlagerstätten von Capillitas, Provincia de Catamarca, Argentinien. By E. Kittl. *Zeits. f. prakt. Geol.* (1925, **33**, 121–124, 140–147).

The Roasting of Copper Concentrate. By A. T. Fry. *Chem. Eng. Min. Rev.* (1926, **18**, 141–144).

Gold.

The Cam and Motor Gold Mines, Southern Rhodesia. By D. V. Burnett. *Mining Mag.* (1926, **34**, 73–85).

The Gold Deposits of Nova Scotia: a New Hypothesis concerning the Structural Features of the Province. By S. Brunton. *Bull. Inst. Min. Met.* (1926, March, pp. 1–18 and 5 plates).

Gold Deposits of Kenora and Rainy River Districts. By E. L. Bruce. *Ann. Rept. Ontario Dept. Mines* (1925, **34**, Part 6, 1–42).

Kamiskotia Gold Area (District of Cochrane). By F. L. Finley. *Ann. Rept. Ontario Dept. Mines* (1925, **34**, Part 6, 43–64).

Tashota–Onaman Gold Area (District of Thunder Bay). By T. L. Gledhill. *Ann. Rept. Ontario Dept. Mines* (1925, **34**, Part 6, 65–85).

Lightning River Gold Area (District of Cochrane). By T. L. Gledhill. *Ann. Rept. Ontario Dept. Mines* (1925, **34**, Part 6, 86–98).

The Goudreau Gold Area. By C. W. MacLeod and G. S. Cowie. *Bull. Canadian Inst. Min. Met.* (1926, No. 167, pp. 393–401).

Kirkland Lake: Ontario's Second Gold District. By E. H. Orser. *Eng. Min. Journ.-Press* (1926, **121**, 317–323).

Geology of the Kirkland Lake Gold Mine. By J. B. Tyrrell and R. E. Hore. *Min. & Met.* (1926, **7**, 118–121).

Australian Gold Mining—Its Decadence and its Resurrection. By G. E. Bassett. *Chem. Eng. Min. Rev.* (1926, **18**, 145–149).

New Coonambula, Mundubbera District, Gold Occurrences. By E. C. Saint-Smith. *Queensland Govt. Min. Journ.* (1926, **27**, 47–48).

Sur les Formations Aurifères du Centre et de l'Ouest-Africain. By H. de Mathelin de Papigny. *Bull. du Comité d'Etudes Historiques et Scientifiques de l'Afrique Occidentale Française* (1925, **8**, 205–211).

Die Golderzlagerstätte von San Ramón, Departement Tupungato, Provinz Mendoza, Argentinien. By E. Kittl. *Zeits. f. prakt. Geol.* (1926, **34**, 40–44).

Flotation of Gold Ores. By W. E. Simpson. *Mining Mag.* (1926, **34**, 89–90).

Iron and Steel.

Mattawin Iron Range, Ontario, to be developed. *Eng. Min. Journ.-Press* (1926, **121**, 295).

Iron and Steel Manufacture in India. By R. Mather. Paper before Sheffield Soc. of Engineers and Metallurgists. Abstr. *Iron & Coal Tr. Rev.* (1926, **112**, 530–531).

The Belgian Steel Industry in 1925. *Iron & Coal Tr. Rev.* (1926, **112**, 485).

Die Magnetitlagerstätten der tschecho-slowakischen Republik. By F. Sellner. *Zeits. f. prakt. Geologie* (1926, **34**, 33–40).

Die Lage der französisch-lothringischen Eisen-industrie. By S. Landshut. *Internat. Bergwirts.* (1925–1926, **1**, 97–100).

Die Aussichten des deutschen Eisenerzbergbaues. By U. Wedding. *Internat. Bergwirts.* (1925–26, **1**, 86–90).

The Iron Ore Mines of the North of Spain. By L. Barreiro. *Iron Age* (1925, Sept. 10). *Abstr. Rev. de l'Ind. Minérale* (1926, No. 125, pp. 37–39).

La Minería de Vizcaya: su Estado actual y su Porvenir. By R. M. De Rotaeche. *Revista Minera* (1926, **77**, 93–95).

Spain—The World's Oldest Producer of Iron Ore. By O. R. Kuhn. *Eng. Min. Journ.-Press* (1926, **121**, 367–372).

Phosphorus Iron Ores on the Cuyuna Range. By G. A. Thiel. *Eng. Min. Journ.-Press* (1926, **121**, 687–690).

Lead.

A Lead and Zinc Deposit in Keewatin Iron Formation. By E. S. Moore. *Bull. Canadian Inst. Min. Met.* (1926, No. 167, pp. 371–378).

Interim Report on Indooroopilly Silver-Lead Mining. By L. C. Ball. *Queensland Govt. Min. Journ.* (1926, **27**, 10–12).

The Durango Lead Smelter and Sulphating Plant. By E. H. Robie. *Eng. Min. Journ.-Press* (1926, **121**, 288–290).

Manganese.

Eine Neuentdeckte Wichtige Manganlagerstätte aus dem Nördlichen Kaukasus. By A. Kolodjažny. *Bergjournal* (1925, No. 5). Abstr. in *Zeits f. prakt. Geologie* (1925, **33**, 167–168).

Mercury.

Ein Zinnoberführender Erzgang im Devon des östlichen Rheinischen Schiefergebirges. By K. Hummel. *Zeits. f. prakt. Geol.* (1925, **33**, 137–140, 154–167).

Nickel.

Welsh Nickel Industry in 1925. *U.S. Commerce Repts.* (1926, No. 8, p. 465).

Platinum.

The Geology and World Distribution of Platinum. By P. Kovaloff. Petrograd, 1923. Abstr. *S. Afr. Min. Eng. Journ.* (1926, **36**, 519–520).

Great Dyke Platinum Areas. Southern Rhodesia as a Rare Metal Producer. *Min. Journ.* (1926, **152**, 237–238).

The Bushveld Igneous Complex. By A. L. Hall. *Journ. Chem. Met. Min. Soc. S. Africa* (1926, **26**, 160–174).

The Platinum Problem in South Africa. By P. Kovaloff. *S. Afr. Min. Eng. Journ.* (1926, **37**, 75).

Tin.

The Geology of Bauchi Town and Surrounding District. By A. D. N. Bain. *Geol. Surv. Nigeria, Bull.* 9. Pp. 38–64. (Publ. by authority of Nigerian Govt., 1926).

The Southern Plateau Tinfields and the Sura Volcanic Line. By J. D. Falconer. *Geol. Survey Nigeria, Bull.* 9. Pp. 19–37. (Publ. by authority of Nigerian Govt., 1926.)

The Geology of Mama. By C. Raeburn. *Geol. Survey Nigeria, Bull.* 9. Pp. 10–19. (Publ. by authority of Nigerian Govt., 1926).

Titanium.

Radio-active Ilmenite near Mount Painter, Northern Flinders Range. By A. C. Broughton. *Trans. Roy. Soc. S. Australia* (1925, **49**, 101–102).

Vanadium.

The Vanadium Content of certain Titaniferous Iron Ores of South Australia. By A. R. Alderman. *Trans. Roy. Soc. S. Australia* (1925, **49**, 88–90).

Zinc.

La première Usine à Zinc du Continent Asiatique. By R. Sevin *Echo des Mines* (1926, **54**, 152–155).

Porosity and Intensive Corrosion. Experiments on Commercial Sheet Zinc and other Materials. By U. R. Evans. *Chem. and Ind.* (1926, **45**, 37T–44T).

NON-METALS.

Asbestos.

Asbestos: with Special Reference to Canada. *Dept. Interior, Natural Resources Intelligence Service Memorandum.* Pp. 32, 13½ × 8½. (Ottawa, Canada, 1926).

Asbestos in New South Wales. *Asbestos* (1926, **7**, No. 7, pp. 6 & 8).

Russian Asbestos Mining Reviving. By L. Berlinraut. *Eng. Min. Journ.-Press* (1926, **121**, 164–167).

The Mining of Asbestos in the Philippines. *Far Eastern Review.* Abstr. in *Asbestos* (1926, **7**, 18).

The Development of Robertson Process Metal. *Asbestos* (1926, **7**, No. 8, pp. 3–6).

Barium Minerals.

Ueber metasomatische Schwerspatvorkommen in Deutschland. By R. Bärtling. Address to German Geol Soc. Abstr. *Glückauf* (1926, **62**, 281).

Clay.

Mineralogy of Clay. By J. S. McDowell. *Journ. Amer. Ceram. Soc.* (1926, **9**, 55–60).

Rational Analysis of Clay. By J. S. McDowell. *Journ. Amer. Ceram. Soc.* (1926, **9**, 61–65).

Coal.

Some Economic Factors of the Coal-Mining Industry. By R. W. Dron. Lecture at Edinburgh University. Abstr. *Iron and Coal Tr. Rev.* (1926, **112**, 222).

The Sinking of a Colliery in the East Nottinghamshire Coalfield. By H. E. Mitton. *Trans. Inst. Min. Eng.* (1926, **70**, Part 5, 345–367).

The Pearson and Dorman Long Enterprise in Kent. By A. E. Ritchie. *Iron and Coal Tr. Rev.* (1926, **112**, 330, 380).

The Production of Durham Coke with Special Reference to the Becker Oven. By E. W. Smith and D. Rider. Paper before Northern Section of Coke Oven Managers' Assoc. Abstr. *Iron and Coal Tr. Rev.* (1926, **112**, 261).

Coal-Cutting by Machinery and Conveyors in Scottish Mines. By G. L. Kerr. *Trans. Min. Inst. Scotland* (1924–5, **46**, 52–60).

Review of the South Wales Coal Industry, 1871–1924. By D. Hannah. Presidential Address to South Wales Inst. Eng., Jan. 19, 1926. *Iron and Coal Tr. Rev.* (1926, **112**, 180, 226–227).

Coal in the Klip River Valley. *S. Afr. Min. Eng. Journ.* (1926, **37**, 55–56).

Carbonisation of Canadian Fuels. By R. E. Gilmore. *Canadian Chem. and Met.* (1926, **10**, 31–34 et seq.).

Sydney Coal Field. By S. C. Mifflen. *Can. Min. Journ.* (1926, **47**, 164–168).

On the Geological Structure of the Karanpura Coalfields, Bihar and Orissa. By A. Jowett. *Mem. Geol. Survey India* (1925, **52**, Part I, pp. 1–144, 4 pl., maps in cover).

The Winning of Brown Coal at Yallourn, Victoria. *Chem. Eng. Min. Rev.* (1926, **18**, 185–191 et seq.).

Czechoslovakian Coal Industry in 1925. *Coll. Guard.* (1926, **131**, 691).

Travaux de la Commission d' Utilisation du Combustible : Onzième Rapport. By H. Giraud. *Bull. de la Soc. d'Enc. pour l'Ind. Nat.* (1926, **125**, 116–129).

Die Kohlen- und Eisenerzförderung des Deutschen Reiches im Jahre 1924 : *Stahl u. Eisen* (1926, **46**, 422–424).

Bericht über die Lage der Kohlenwirtschaft. *Glückauf* (1926, **62**, 469–472, 500–503).

Der deutsche Kohlenbergbau im Jahre 1925. *Montan. Runds.* (1926, **18**, 212–213).

Die Entwicklung und die Interessensphären der deutschen Braunkohlen-Syndikate. By M. Heinz. *Internat. Bergwirts.* (1925–6, **1**, 95–96).

High Temperature Carbonisation in 1925. By E. V. Evans. *Fuel Econ. Rev.* (1926, **5**, 7–10).

Short Review of Development in Coke and Blast Furnace Technology in 1925. By E. C. Evans. *Fuel Econ. Rev.* (1926, **5**, 18–25).

The Application of the Chance Sand Flotation Process to Washing Bituminous Coal. By A. Greenwell. *Fuel in Science and Practice* (1926, **5**, 163–166).

Low Temperature Carbonisation. By C. H. Lander. *Fuel Econ. Rev.* (1926, **5**, 10–13).

Low Temperature Carbonisation. By D. Brownlie. *Trans. Inst. Min. Eng.* (1926, **71**, Pt. I, 181–247).

Some Considerations of the Commercial Aspects of Low Temperature Carbonisation. By A. H. Lymn. *Iron and Coal Tr. Rev.* (1926, **112**, 332–374).

Untersuchung der Feinkohlen und Regeln für ihre wirtschaftliche Aufbereitung. By K. Reinhardt. *Glückauf* (1926, **62**, 485–496, 521–528).

The Micro-Structure of Coal. By R. Thiessen. *Journ. Roy. Soc. Arts* (1926, **74**, 535–557 with discussion).

Benzolgewinnung durch Vakuumdestillation. By R. Kattwinkel. *Glückauf* (1926, **62**, 529–534).

La Fabrication du Coke Métallurgique en 1925. *Echo des Mines* (1926, **54**, 81–82).

Coke for Blast-Furnace Purposes. By E. C. Evans. Paper before *Cleveland Inst. Eng.*, Middlesbrough. Abstr. *Iron & Coal Tr. Rev.* (1926, **112**, 425–426, 486–487).

American and French Work on the Combustibility of Coke. By L. Korevaar. *Fuel in Science and Practice* (1926, **5**, 92–97).

Combustibility of Blast-Furnace Coke. By R. A. Sherman and S. P. Kinney. *Fuel in Science and Practice* (1926, **5**, 98–105).

The Economic Aspect of the Bergius Coal Liquefaction Process. By F. Bergius. Address at 105th Anniversary Assoc. for the Promotion of Industrial Activity, Berlin. Abstr. *Iron & Coal Tr. Rev.* (1926, **112**, 333).

Pulverised Fuel: some limitations and comparisons. By E. W. L. Nicol. *Cassiers Ind. Management, Works Power No.* (1926, **13**, 57–61).

Graphite.

Monografia del Grafito. By J. A. García. *Bol. Minero* (1926, **21**, 64–75 and map).

Le Graphite en Indo-Chine. By J. Duclos. *Bull. des Mines de Madagascar* (1925, No. 36, pp. 195–197).

Petroleum.

Das Erdöl in der Weltwirtschaft und Weltpolitik. By L. Waagen. *Internat. Bergwirts.* (1926, **1**, 153–156).

A Review of the British Shale Oil Industry. *Chem. Age* (1926, **14**, 199–200).

The Scottish Shale-Oil Industry. Report of the Court of Investigation on the Wages Question. Summary in *Petr. Times* (1926, **15**, 599–602, 639–643).

Oil Possibilities in Queensland. By H. T. Jensen. *Queensland Govt. Min. Journ.* (1926, **27**, 12–19, 48–52 with geological maps).

New Oil Regions in the U.S.S.R. and their future Development. By V. V. Belgas. *Soviet Union Monthly* (1926, **1**, 34–35).

Les Points d'Aboutissement possibles de la Route des Pétroles. By Blosset. *Bull. des Mines de Madagascar* (1925, No. 36, pp. 191–194).

Review of American Petroleum Production for 1925. By F. J. Fohs. *Min. & Met.* (1926, **7**, 134–136).

Relation of Volcanic Dikes to Oil-Bearing Formations of Southern Ecuador, South America. By G. Sheppard. *Econ. Geology* (1926, **21**, 70–80).

Symposium on the Estimation of Unsaturated Hydrocarbons. *Journ. Inst. Petr. Techn.* (1926, **12**, 48–67).

The Torsion Balance and Oil-Finding. By J. B. Reid. *Petr. World* (1926, **23**, 85–90, 92).

Surveying Oil Wells with Anderson Apparatus. By F. M. Smith. *Eng. Min. Journ.-Press* (1926, **121**, 241–246).

Gas as a Factor in the Production of Oil. By K. C. Sclater. *Mining and Metallurgy* (1926, **7**, 169–171).

Potash.

Potash discovered in New Mexico while drilling for oil. *Eng. Min. Journ.-Press* (1926, **121**, 296).

Radium Minerals.

Ueber ein neues Vorkommen von Uranpechblende auf der Bergfreiheitgrube in Schmiedeberg i. R. By E. Meister. *Zeits. f. prakt. Geologie* (1926, **34**, 44–45).

Commercial Production of Radium, Mesothorium and Helium. *Ind. Eng. Chem.* (1926, **18**, 198–211).

Metallic Uranium. By J. F. Goggin, J. J. Cronin, H. C. Fogg and C. James. *Ind. Eng. Chem.* (1926, **18**, 114–116).

Refractories.

Ontario Quartzites available for the Manufacture of Silica Brick. By E. S. Moore and G. B. Langford. *Can. Min. Journ.* (1925, **46**, 1110–1112).

Some Notes on the Use of Sillimanite in Glass-Furnace Practice. By F. G. Clark and W. J. Rees. *Journ. Soc. Glass Techn.* (1925, **9**, 383–388).

Commercial Sillimanite as a Refractory Material in Glass Making. By A. Cousen and W. E. S. Turner. *Journ. Soc. Glass Techn.* (1925, **9**, 334–371).

Formation of Mullite from Cyanite, Andalusite and Sillimanite. By J. W. Greig. *Amer. Journ. Science* (1926 [v] **11**, 1–26).

Carborundum Refractories. By I. Stewart. *Chem. Eng. Min. Rev.* (1926, **18**, 151–154).

Contribution à l'Étude des Briques silice. Analyse dilatométrique. Essais de la Matière première. By Travers and de Goloubinoff. *Rev. de Mét.* (1926, **23**, 27–47, 100–117).

Sodium Salts.

Geschichtliches über den österreichischen Salzbergbau. By H. Kämpf. *Montan. Runds.* (1926, **18**, 148–149).

Deutschlands Bodenschätze an Steinsalz und ihre wirtschaftliche Bedeutung. By Ph. Fabian. *Internat. Bergwirts.* (1926, **1**, 157–158).

Saline Lakes of the Mohave Desert Region. By W. F. Foshag. *Econ. Geology* (1926, **21**, 56–64).

NOTICES OF RECENT LITERATURE.

PERU: A COMMERCIAL AND INDUSTRIAL HANDBOOK. By W. E. Dunn and other representatives of the United States Department of State, Commerce and Agriculture. Pp. viii + 530, 9 × 6. (Washington: Government Printing Office, 1925.) Price $1·25.

This is one of a series of handbooks on South American countries issued by the United States *Bureau of Foreign and Domestic Commerce* and contains a remarkable amount of information useful to travellers, traders and investors. Many items of interest concerning the mineral industry are also given.

The total investment in mining properties in Peru is estimated at about $100,000,000, but if the Government schemes for new roads and railways is pressed forward this amount is likely to be greatly increased. The total value of the mineral production in 1903 was about $7,000,000 as compared with $57,000,000 in 1923. Of the latter amount about 90 per cent. was from districts opened up by the Central Railway, the only line yet built to mineralised regions of the country. In fact,

actual development has been in direct ratio to the availability of transport facilities. In 1923, Peru ranked first of all countries as a producer of vanadium, third in regard to silver, sixth in copper and ninth in petroleum. In order of importance the principal items were petroleum, copper, silver, gold, vanadium and coal. Other mineral products were borax and ores of tungsten, lead, mercury, molybdenum, antimony, bismuth, nickel and zinc.

Excepting the petroleum fields of the northern coastal zone, the mineral areas are almost entirely in the Andean region, an irregular belt from 150 to 200 miles wide and varying in elevation up to 16,000 feet above sea level. The most important known deposits are in the central Sierra region, in the Departments of Cajamarca, Libertad, Ancachs, Western Huanuco, Junin, Lima and Huancavelica.

The book gives brief descriptions and statistics of each important mineral and has a separate chapter on petroleum. The most important development taking place at present is near Quiruvilca, 60 miles east of Trujillo, where a subsidiary of the American Smelting and Refining Company is spending about $6,000,000 in opening up copper and silver deposits.

Much information is given in regard to transport and communication facilities, which are at present very poor. Peru has an area of more than 500,000 square miles with a coast line of about 1,400 miles. At the beginning of 1924, there were only 2,018 miles of railway in operation and about 2,500 miles of road available for motor traffic. Of the latter, only about 250 miles could be considered good, while many sections are only a few miles long, the longest being about 100 miles. A list is given of new schemes of railway and road construction that are being put into effect very slowly as funds become available. Hitherto, nearly all efforts have been expended in railway construction, but the development of motor transport has led to better recognition of the advantage of roads, owing to their lower cost and ability to handle all the traffic likely to develop for many years in most newly-opened regions. As the exploitation of the undoubted mineral wealth of Peru depends upon the development of transport facilities, this section of the book is of considerable interest and value.

STAINLESS IRON AND STEEL. By J. H. G. Monypenny, F.Inst. P. Pp. ix + 304, 10 × 6½. (London: Chapman & Hall, Ltd., 1926.) Price 21*s*.

The subject of stainless steel has never before been adequately treated in a single publication such as is here presented. The author is well qualified to write upon the

subject, being Chief of the Research Laboratory of the Brown, Bayley Steel Works, Ltd., Sheffield, whose Works Manager is Harry Brearley, the original inventor in 1913 of steel for stainless cutlery. Notwithstanding the large amount of research work previously done on steels containing chromium, no one had discovered that a high percentage of that element in a steel made it so resistant to corrosion. Brearley's specifications gave a range of composition of 9 to 16 per cent. of chromium and less than 0·7 of carbon, preferably less than 0·4 per cent., with small amounts of other metals. The term stainless steel is now applied to a large range of alloy steels, containing not only chromium but in addition, nickel, silicon, molybdenum, etc., and having numerous uses. The steel, besides its uses for table cutlery, is also used for pocket knives, scissors, surgical instruments, valves of aeroplane engines, parts of locomotives and pumps, bladings of both impulse and reaction types of steam turbines, certain chemical pumps and other apparatus. In every case for the use of stainless steel a compromise must be reached between the requirements for hardness and for corrosion-resisting properties of the material, as it is not possible to get a maximum of both at the same time in the same steel.

In a series of eight chapters the author deals exhaustively, in regard to stainless iron and steel, with the influence of chromium on hardness and structure, with manufacture and heat treatment, and with production of various mechanical and physical properties and resistance to various corroding media. The last two chapters deal respectively with special stainless steels and their various applications.

The author is to be congratulated on producing a valuable book, full of every kind of information on stainless steel, clearly written and profusely illustrated with diagrams and photomicrographs. The publishers are also to be complimented on the excellence of their work.

STATEMENT AND ENGINEERING REPORT BY THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO SUBMITTED TO THE INTERNATIONAL JOINT COMMISSION RESPECTING THE PROPOSAL TO DEVELOP THE ST. LAWRENCE RIVER, 1921. Pp. 119 + 13 plates, 10 × 7. (Toronto, 1925.) Price $7·50.

The utilisation of the water-power resources of the international portion of the St. Lawrence River has been for many years a subject of great importance to both the peoples of eastern Canada and of the north-eastern United States. In January 1920, the governments of the two countries appointed an International Joint Commission to look into the matter, and, with the object of assisting it, the Hydro-Electric Commission of Ontario agreed to furnish a report embodying all

the information it possessed. The report, completed in November 1921, was duly delivered to the International Commission, who have not as yet issued any statement as to their findings. The Hydro-Electric Commission eventually decided that it was in the public interest that the information they had collected should be published, and issued it under the above title in 1925.

The Report is divided into various sections, including a statement of 38 pages by the Commissioners, an engineering report of 61 pages, appendices giving 13 pages of information as to costs and other matters of the various schemes proposed, and 13 maps mainly of the international part of the St. Lawrence illustrating the various proposals for navigation of the river in conjunction with the development of its power resources. As some time had elapsed between the signing of the report and its issue, footnotes have been added to the text to give and explain information which has become recently available

The Report is of great interest and is full of information, its clearness being greatly augmented by the excellent plans supplied. The statement deals fully with the hydro-electric industry in Ontario and its great growth, as well as future demands for power both in Canada and the United States, which could be supplied within about 300 miles from the part of the St. Lawrence under consideration. The engineers to the Commission recommended three alternative schemes of development, which would yield from 1,492,000 to 1,635,000 h.p. at a capital cost of about $95 per unit, exclusive of costs apportioned to navigation. In addition, initial schemes allowing for complete navigation improvements, and also for 14 feet navigation only, are provided.

The statement concludes with the remark that the Commission feel assured that the St. Lawrence River presents one of the most attractive commercial power propositions existing in the North American continent.

HYDROLOGY AND GROUND WATER. A Practical Textbook for the use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water. By J. M. Lacey, M.Inst.C.E. Pp. viii + 159, 9 × 6. (London: Crosby Lockwood & Son, 1926.) Price 12*s*. 6*d*.

The author mentions in his preface that the want of a comprehensive book on hydrology induced him to write this textbook, which is one suitable for engineers engaged in water works, irrigation and drainage schemes. It contains much matter of interest also to those engaged in the study of climate and to general readers.

The various headings under which the matter is divided include: rainfall, its measurement and variation, its records, percolation through and evaporation from different classes of soils, also surface flow of rain water under different conditions of soil; ground water, its yield from different rocks and soils; flow through different media; springs and artesian water; floods, their causes and effects, and damage caused. The concluding part of the book deals with the nature of different classes of wells.

A number of good illustrations and tables of data are incorporated in the text. The book is well printed and bound, and can be recommended as a very useful addition to the library of the civil engineer.

SURVEYING FOR SETTLERS. A simplified Handbook for the use of Pioneers, Farmers, Planters and Others settling in New Countries. By William Crosley, Mem.Inst.C.E., Mem.Inst.M.M. Second Edition. Pp. xii + 159, 7 × 4½. (London: Crosby Lockwood & Son, 1926.) Price 5s.

The first edition of this useful manual has already been reviewed in this BULLETIN (1922, **20**, 277). The issue of a new edition, which is slightly enlarged, shows that the book has been much appreciated.

MONTHLY MINERAL AND METAL STATISTICS.

October, 1925—March, 1926.

Owing to lack of space, only the more important monthly statistics relating to the production of and trade in the principal minerals and metals can be included in the following pages. Anyone requiring further information on these or other minerals and metals should communicate with the Director, Imperial Institute, South Kensington, London, S.W.7.

Where the descriptions "Imports" and "Exports" are used without qualification in the following pages, "Imports" is equivalent to "Imports for home consumption," while "Exports" represents "Exports of domestic produce."

A blank space in the columns indicates that information has not yet been received, whereas a dash indicates that, so far as can be ascertained, no production or trade took place.

The units of quantity adopted for these returns are the British statute hundredweight and ton of 112 lb. (avdp.) and 2,240 lb. (avdp.) respectively, the imperial gallon and the metric carat. For precious metals the troy ounce has been used.

In those cases where values expressed in pounds sterling are given in place of quantities, the original values have been converted to pounds sterling at average rates of exchange with the exception of those for the Union of South Africa, Australia and New Zealand, in which cases the original currency values are given.

Total figures given for the whole of the year 1925 should be regarded as provisional only.

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925	January 1926.	February 1926.	March 1926.
ALUMINIUM								
British Empire								
United Kingdom :								
Exports of ingots, blocks, etc.	Long ton	377	275	133	3,744	496	433	258
Canada :								
Imports of cryolite . .	Long ton	33	69	3	673	60	9	79
Imports of alumina . .	do.	3,321	3,702	5,329	56,922	5,403	5,705	7,586
Exports of blocks, bars, etc .	do	880	1,680	820	16,637	1,249	1,006	837
British Guiana :								
Production of bauxite . .	Long ton				194,339			
Exports of bauxite . .	do.	11,934	11,201	13,652	174,999	6,634	15,049	13,034
Foreign Countries								
Belgium–Luxemburg E.U. :								
Imports of bauxite . .	Long ton	288	216	227	3,542	251	114	161
Imports of crude aluminium and scrap	do.	120	125	93	990	54	52	75
Czechoslovakia :								
Imports of cryolite . .	Long ton					25	50	55
Imports of sheets, plates, etc. .	do.					11	28	11
France :								
Production of bauxite . .	Long ton	34,477	31,877	34,361	400,001	31,917	30,300	41,496
Exports of bauxite, etc. . .	do.	22,464	15,490	20,919	211,510	14,508	14,028	9,250
Exports of anhydrous alumina	do.	1,853	1,491	1,811	21,188	3,109	327	1,521
Exports of hydrate of alumina.	do.	218	1,537	87	3,774	4	102	183
Production of aluminium .	do.				21,000			
Exports of ingots, scrap and wrought aluminium . .	do.	232	295	173	3,244	224	129	83

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
ALUMINIUM—(*contd.*)								
Germany :								
Exports of crude bauxite and natural cryolite . . .	Long ton	—	—	—	469	—	5	—
Production of aluminium .	do.				25,000			
Exports of crude, scrap and wrought aluminium . .	do.	548	1,800	1,991	7,489	2,601	1,673	1,488
Imports of crude, scrap and wrought aluminium .	do.	433	450	359	10,734	444	295	251
Italy :								
Production of bauxite . .	Long ton				195,000			
Production of aluminium. .	do.				1,800			
Imports of ingots, etc., sheets, bars and tubes . . .	do.	858	701	414	6,579	422	245	201
Norway :								
Total imports of bauxite . .	£	—	—	55,904	284,202	3,103	771	59,678
Total imports of cryolite . .	£	9,096	4,738	12,135	75,871	454	5,751	4,173
Total imports of alumina. .	£	55,025	35,268	80,011	612,272	55,497	28,442	22,637
Exports of ingots and sheets .	Long ton	1,909	1,292	1,761	20,319	1,806	1,123	2,528
Switzerland :								
Exports of blocks, etc., scrap, sheets, tubes, and wire, including some alloys . . .	Long ton	849	1,397	1,797	15,639	760	818	947
United States :								
Production of bauxite . .	Long ton				316,540			
Total imports of crude bauxite.	do.	20,382	35,583	15,826	353,696	7,312	23,122	18,938
Total imports of cryolite . .	do.	2,500	2,155	64	9,844	—	—	—
Exports of bauxite, etc. . .	do.	8,966	4,936	6,172	78,570	4,408	4,359	14,416

Total imports of ingots, scrap and alloys, plates and sheets, etc.	do.	2,459	2,695	4,855	19,425	3,150	3,404	2,403
Exports of ingots, scrap and alloys, plates and sheets, etc.	do.	155	103	239	5,644	123	190	381
Dutch Guiana :								
Exports of bauxite . . .	Long ton				84,150			
ASBESTOS								
BRITISH EMPIRE								
United Kingdom :								
Total imports of raw asbestos, fibre and waste, including asbestic	Long ton	1,788	1,984	3,152	26,808	1,731	1,203	2,882
Re-exports of raw asbestos, fibre and waste, including asbestic	do.	142	175	680	5,580	214	114	255
Southern Rhodesia :								
Production of asbestos . .	Long ton	3,396	3,138	2,674	30,669	2,279	1,934	2,311
Exports of asbestos . .	do	8,420	3,551	2,170	30,107			
Union of South Africa :								
Sales and shipments in Transvaal	Long ton	626	617	616	6,810	407	786	917
Sales and shipments in Cape of Good Hope . . .	do.	187	140	349	2,268	210	266	228
Exports from Union of raw asbestos	do.	586	332	696	5,922			
Canada :								
Production of asbestos . .	Long ton				251,485			
Exports of asbestos . .	do.	11,013	11,941	8,566	122,098	9,985	9,090	9,463
Exports of asbestos sand (i.e. short fibre) and waste . .	do.	10,312	12,255	10,416	108,274	11,567	9,568	11,681

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
ASBESTOS—(*contd.*)								
FOREIGN COUNTRIES								
Belgium–Luxemburg E.U.:								
Imports of raw asbestos and fibre	Long ton	931	1,293	1,509	10,663	2,319	742	1,328
Exports of raw asbestos and fibre	do.	14	12	7	246	59	21	3
Germany:								
Imports of raw asbestos and fibre	Long ton	946	1,569	726	11,965	546	371	514
Italy:								
Production of asbestos . .	Long ton				2,490			
Imports of asbestos . .	do.	622	153	513	6,338	204	302	149
Exports of asbestos . .	do.	49	132	114	921	143	83	57
Netherlands:								
Imports of asbestos . .	Long ton	203	59	134	1,286	45	260	37
United States:								
Total imports of unmanufactured asbestos	Long ton	22,013	19,161	17,564	205,821	18,374	18,482	21,876
BARIUM MINERALS								
BRITISH EMPIRE								
United Kingdom:								
Production of unground barytes and witherite in Great Britain	Long ton	(*b*) 2,350	(*b*) 2,350	(*b*) 2,350	36,336			
Production of ground barytes and witherite in Great Britain .	do.	(*b*) 1,088	(*b*) 1,088	(*b*) 1,088	12,345			
Total imports of ground barytes (*a*)	do.	3,700	3,647	2,956	42,630	2,669	3,597	3,374
Exports of ground barytes (*a*) .	do.	341	52	511	3,339	295	42	32
Southern Rhodesia:								
Production of barytes	Long ton	—	13	—	36	—	—	—

Canada :								
Imports of barytes	Long ton	235	287	230	2,173	120	144	187
Australia (Tasmania) :								
Production of barytes	Long ton	—	—	—	4	—	—	—
FOREIGN COUNTRIES								
Czechoslovakia :								
Imports of crude barytes	Long ton					98	394	315
Imports of ground barytes	do.					35	445	283
France :								
Imports of barytes	Long ton	750	890	899	8,557	739	597	1,612
Exports of barytes	do.	82	43	220	1,563	125	162	83
Imports of witherite	do.	50	—	31	1,273	—	20	110
Germany :								
Exports of barytes and celestite	Long ton	16,508	14,752	9,577	165,609	8,726	11,545	12,150
Imports of barytes and celestite	do.	—	—	—	2,301	201	—	217
Italy :								
Production of barytes	Long ton				31,300			
Netherlands :								
Imports of barytes	Long ton	5,839	4,845	2,312	52,360	2,705	2,336	2,633
CADMIUM								
Australia :								
Cadmium content of ore produced in Tasmania	Lb	(b) 709	(b) 709	(b) 709	11,750	(c) 1,062	(c) 1,062	(c) 1,062
Cadmium produced in Tasmania from other than Tasmanian ores	do	(b) 35,022	(b) 35,022	(b) 35,022	388,911	(c) 34,330	(c) 34,330	(c) 34,330
Exports overseas of cadmium from :								
New South Wales	do.	—	—	—	71,456	—	—	35,840
Victoria	do.	24,640	36,960	39,200	219,520	35,840	53,760	—
Tasmania	do.	—	—	—	156,324	5,264	—	—
France :								
Imports of cadmium	Lb.	29,974	14,767	14,767	171,471	12,783	13,225	3,069

(a) *Including precipitated barium sulphate.* (b) *Monthly average of fourth quarter, 1925.* (c) *Monthly average of first quarter, 1926.*

Particulars.	Unit.	October 1925.	November 1925	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
CHINA CLAY								
EXPORTS FROM BRITISH EMPIRE								
United Kingdom (including Cornish or china stone)	Long ton	64,680	43,713	62,356	652,576	48,531	49,867	55,507
EXPORTS FROM FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.	Long ton	178	120	144	7,085	118	109	442
Czechoslovakia	Long ton	18,418	23,526	18,294	236,280	15,336	15,694	16,443
Denmark	Long ton	354	98	61	4,136	—	—	—
France	Long ton	250	473	397	5,210	469	280	1,599
Germany	Long ton	3,691	2,544	3,122	28,455	2,263	2,300	3,195
IMPORTS INTO BRITISH EMPIRE								
Canada	Long ton	3,089	1,031	1,765	16,245	706	844	1,259
India (total imports from overseas)	Long ton	2,733	1,366	1,162	24,531	1,898	1,413	1,628
IMPORTS INTO FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.	Long ton	3,762	3,471	4,978	42,535	3,670	5,522	5,649
Czechoslovakia	Long ton					156	233	157
Denmark	Long ton	74	1,005	163	5,310	569	387	161
France	Long ton	5,027	2,203	6,089	54,737	3,450	5,878	5,601
Germany	Long ton	21,037	19,638	14,358	223,022	11,939	18,304	14,092
Italy	Long ton	4,683	3,030	2,666	39,931	1,916	5,317	3,534
Netherlands	Long ton	4,836	4,688	2,312	52,360	2,866	2,994	3,593
United States (total imports)	Long ton	22,550	28,256	26,897	332,622	24,295	17,301	56,050

CHROME ORE								
BRITISH EMPIRE								
Southern Rhodesia :								
Production	Long ton	9,590	13,471	14,226	121,274	11,654	7,748	8,970
Exports	do	401	30,204	11,147	129,260			
Union of South Africa :								
Sales and shipments	Long ton	557	—	356	11,137	541	229	1,052
Exports from Union	do.	111	1	5,406	5,933			
India :								
Exports overseas	Long ton	1,000	2,190	800	36,157	2,850	4,295	4,300
FOREIGN COUNTRIES								
Czechoslovakia :								
Imports	Long ton					130	103	187
Germany :								
Imports	Long ton	1,239	1,051	11,031	25,468	1,274	1,480	2,883
Norway :								
Total imports of chrome ore	£	2,831	—	10,889	34,983	2,517	—	3,728
Exports of ferro-chrome	Long ton	87	186	119	2,486	119	289	254
Cuba :								
Production	Long ton				11,655			
United States :								
Total imports	Long ton	10,281	12,899	12,848	149,739	11,040	15,357	17,000
New Caledonia :								
Exports	Long ton				18,208			
COAL								
PRODUCTION OF COAL IN BRITISH EMPIRE								
Great Britain	Long ton	20,894,900	20,363,200	22,526,000	244,418,400	21,591,800	21,314,300	23,852,200
Southern Rhodesia	Long ton	59,246	62,564	65,362	678,320	66,716	62,481	61,866
Union of South Africa (a)	Long ton	1,004,155	1,030,552	1,129,695	13,582,451	902,959	938,754	1,022,272

(a) *Quantity of coal mined less waste sorted.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
COAL—(*contd.*)								
Canada :								
Bituminous coal	Long ton	826,000	846,000	865,000	7,980,340	697,323	628,858	744,566
Sub-bituminous coal	do.	51,000	86,000	91,000	509,477	57,049	45,824	35,210
Lignite	do.	525,000	553,000	434,000	3,232,862	338,171	279,054	171,618
India (*a*)	Long ton	1,875,572	1,530,351	1,843,940	19,878,176	1,783,308	2,066,960	1,983,338
Australia :								
New South Wales	Long ton				11,396,199			
Western Australia (*b*)	do.	1,259	1,347	1,765	37,511	2,983	3,752	6,429
Tasmania	do.	(*c*) 7,228	(*c*) 7,228	(*c*) 7,228	81,698	(*e*) 6,670	(*e*) 6,670	(*e*) 6,670
PRODUCTION OF COAL IN FOREIGN COUNTRIES								
Austria :								
Coal	Long ton	14,755	14,182	14,607	142,077	14,335	12,500	13,290
Brown coal	do.	259,832	259,815	282,279	3,009,597	286,969	245,180	272,634
Belgium	Long ton	2,020,733	1,847,838	1,905,545	22,761,377	1,944,558	1,864,023	2,098,611
Czechoslovakia :								
Coal	Long ton	1,192,802	1,178,189	1,224,416	12,549,474	1,183,505	1,017,240	1,060,330
Brown coal	do.	1,778,305	1,778,347	1,754,651	18,487,130	1,616,320	1,498,605	1,602,209
France :								
Coal produced in Saar	Long ton	1,205,283	1,071,948	1,103,623	12,781,084	1,094,776	1,084,360	1,246,516
Coal produced in other districts	do.	4,118,364	3,929,983	3,935,117	46,291,507	4,093,991	3,941,031	4,400,459
Brown coal	do	90,704	83,176	84,638	991,082	88,901	81,438	92,179
Germany (excluding Saar) :								
Coal	Long ton	11,757,986	11,009,636	11,184,582	130,595,951	11,010,165	10,440,686	11,240,674
Brown coal	do.	12,554,419	11,748,197	12,508,071	137,543,093	12,025,613	10,936,745	11,644,709
Hungary :								
Coal	Long ton	69,623	64,960			(*d*) 62,610	(*d*) 62,610	68,833
Brown coal	do.	563,638	545,530			(*d*)462,567	(*d*)462,567	439,815

Italy:								
Anthracite	Long ton				15,200			
Bituminous coal . . .	do				173,000			
Brown coal	do				956,100			
Netherlands (excluding brown coal)	Long ton	665,737	639,806	645,279	7,001,892	621,000	582,000	695,000
Poland:								
Coal	Long ton	2,540,083	2,507,961	2,417,509	28,613,134	2,417,000	2,108,000	2,258,000
Brown coal	do	5,910						
Russia	Long ton	1,901,000	1,888,000	2,029,000	17,398,000	1,993,000	2,105,000	2,257,000
Spain	Long ton				6,151,112			
Algeria	Long ton	447	163	937	9,869			
Belgian Congo . .	Long ton				80,000			
United States:								
Anthracite	Long ton	61,000	135,000	236,000	55,193,883	154,000	1,860,000	7,848,000
Bituminous co l .	do	47,503,000	45,339,000	47,157,000	466,935,000	17,912,000	41,587,000	41,194,000
Chile	Long ton	113,633	123,800	114,623	1,417,275	93,170	112,914	119,295
French Indo-China (exports) .	Long ton	85,637	70,873	90,347	690,181	60,721		
Japan	Long ton				29,000,000			
COBALT								
BRITISH EMPIRE								
Canada: .								
Ontario								
Production of metal . .	Cwt	(c) 188	(c) 188	(c) 188	2,693	(c) 100	(c) 100	(e) 100
Production of oxide . .	do	(c) 339	(c) 339	(c) 339	5,139	(e) 311	(e) 311	(e) 311
Dominion .								
Exports of metal .	do	239	213	101	2,616	183	157	61
Exports of oxide and salts .	do	609	570	2,617	7,794	424	248	494
Australia (Queensland):								
Production of concentrates .	Cwt	(c) 155	(c) 155	(c) 155	1,800	(e) 113	(e) 113	(e) 113
Exports of ore overseas . .	do	1,653	—	2,335	11,884	146	—	—

(a) *Excluding Indian States.* (b) *Exports from the State, not necessarily overseas, and including bunkers* (c) *Monthly average of fourth quarter, 1925*
(d) *Monthly average of January and February* (e) *Monthly average of first quarter, 1926*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
COBALT—(*contd.*)								
FOREIGN COUNTRIES								
France:								
Imports of oxide . . .	Cwt.	32	474	303	3,237	242	98	328
Exports of ore . . .	do.	—	1,132	—	1,134	—	—	—
United States:								
Total imports of ore and metal	Cwt.	224	153	64	1,877	25	271	345
Total imports of oxide . .	do.	293	117	387	2,565	967	331	258
COPPER								
BRITISH EMPIRE								
United Kingdom:								
Total imports of ore, regulus, matte, cement-copper and scale	Long ton	2,059	5,378	2,223	36,763	1,555	50	7,303
Total imports of unwrought copper	do.	13,209	12,864	7.596	144,104	9,821	12,539	10,675
Re-exports of unwrought copper	do.	231	133	831	6,858	335	1,864	156
Exports of unwrought copper .	do.	244	468	472	4,429	271	384	1,767
Total imports of wrought copper	do.	1,953	1,401	1,612	22,319	1,074	1,576	1,531
Exports of wrought copper .	do.	1,738	1,727	1,931	20,872	1,954	1,867	2,104
Northern Rhodesia:								
Smelter output . . .	Long ton	—	—	—	(*a*) 68	—	—	—
Southern Rhodesia:								
Smelter output . . .	Long ton	73	—	—	1,686	—	—	—
South-West Africa Territory:								
Exports of copper ore . .	Long ton	1,598	11,056	7,362	53,401			

Union of South Africa :								
Copper content of marketable products :								
Transvaal	Long ton	529	460	386	5,482	638	525	696
Cape of Good Hope . .	do	196	229	207	2,614	232	199	197
Canada :								
Copper content of ore produced in the Dominion . .	Long ton				49,740			
Copper content of matte exported from Ontario .	do.	(b) 1,061	(b) 1,061	(b) 1,061	8,963	(c) 843	(c) 843	(c) 843
Smelter output in the Dominion	do	2,768	2,418	3,013	24,735	2,707	2,548	2,631
Exports from the Dominion :								
Copper content of ore, matte and regulus . . .	do.	815	2,757	4,202	27,021	2,141	1,620	4,411
Blister copper . . .	do.	1,857	1,324	2,407	21,678	1,612	2,187	2,788
Unwrought copper and scrap	do.	123	280	167	2,502	71	160	360
Imports into the Dominion :								
Unwrought copper and scrap	do	501	476	583	5,403	449	427	2,136
Wrought copper . . .	do	1,187	1,253	932	13,704	860	983	721
India :								
Production of matte in Burma .	Long ton	750	800	845	8,029	(c) 857	(c) 857	(c) 857
Australia :								
Queensland :								
Copper content of ore produced	Long ton	(b) 224	(b) 224	(b) 224	3,909	(c) 30	(c) 30	(c) 30
Tasmania :								
Copper content of ore produced	Long ton	(b) 537	(b) 537	(b) 537	6,539	(c) 596	(c) 596	(c) 596
Commonwealth :								
Output of blister copper .	Long ton	554	772	1,421	10,984	518	870	1,071
Value of matte and ingots exported	£	33,579	41	46,778	242,366	1,488	1,576	34,188

(a) *Including an adjustment for the period 1920–24 inclusive.* (b) *Monthly average of fourth quarter, 1925.* (c) *Monthly average of first quarter, 1926.*

Particulars.	Unit.	October 1925.	November 1925	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
COPPER—(*contd.*)								
FOREIGN COUNTRIES								
Austria :								
Production of ore	Long ton	7,109	6,623	6,481	79,332	6,488	7,848	7,850
Belgium–Luxemburg E.U. :								
Imports of ore	Long ton	2,523	2,287	1,862	45,382	8,384	4,708	377
Imports of unwrought copper	do.	1,305	1,553	2,712	22,710	718	1,697	1,605
Exports of unwrought copper	do.	853	1,007	1,310	12,244	735	886	1,262
Imports of wrought copper	do.	447	407	596	5,665	429	400	669
Exports of wrought copper	do.	754	349	449	4,777	398	475	388
Czechoslovakia :								
Exports of ore	Long ton					83	183	486
Imports of unwrought copper and scrap	do.					668	1,015	979
Exports of unwrought copper and scrap	do					182	152	484
France :								
Production of ore	Long ton	512	644	478	2,735	849	1,175	1,992
Germany :								
Imports of ore, matte and calcined cupreous pyrites	Long ton	10,290	9,275	21,492	(*a*) 84,863	9,973	13,282	6,246
Exports of ore, matte and calcined cupreous pyrites	do.	4,883	2,923	5,050	20,773	499	1,879	3,512
Imports of unwrought copper	do.	10,887	9,535	8.828	207,567	8,444	7,626	10,887
Exports of unwrought copper	do.	2,371	3,402	3,104	17,635	3,298	2,677	2,206
Imports of wrought copper	do.	44	31	12	380	39	30	16
Exports of wrought copper	do.	3,068	2,684	3,052	29,018	2,504	3,103	3,532
Italy :								
Production of ore	Long ton				6,070			
Smelter production	do.				492			

Netherlands :								
Imports of unwrought and wrought copper and scrap .	Long ton	750	624	676	9,010	748	939	594
Re-exports of unwrought and wrought copper and scrap .	do.	336	110	431	5,928	129	207	331
Spain :								
Copper content of ore produced	Long ton				30,000			
Algeria :								
Production of ore	Long ton	269	231	157	1,722	(b) 290	(b) 290	(b) 290
Belgian Congo :								
Smelter output	Long ton	7,639	7,343	5,889	88,168	6,106	6,094	6,348
Cuba :								
Copper content of ore produced	Long ton				10,592			
Mexico :								
Copper content of ore produced	Long ton	5,436	4,596	8,126	50,511	1,351	4,467	4,563
Smelter output	do.	3,274	3,123	3,324	32,365	3,039	2,811	3,374
United States :								
Copper content of total imports of ore, concentrates, matte and regulus	Long ton	5,331	5,891	4,843	72,915	6,231	3,956	6,720
Primary copper obtained from U.S. mines	do.	63,231	60,179	62,113	751,890	63,416	[illegible]	67,366
Smelter output	do.	74,320	70,217	70,790	846,542	70,157		72,071
Total imports of unrefined copper	do.	13,384	12,761	14,645	169,345	16,229		13,400
Total imports of refined copper	do.	3,613	5,827	6,348	44,542	6,155		3,624
Exports of refined copper .	do.	26,649	26,432	29,882	432,172	27,865	2	32,225
Total imports of scrap . .	do.	565	398	265	4,655	238		1,328
Exports of scrap	do.	114	441	112	5,404	210	31	706
Exports of wrought copper .	do.	801	402	950	11,899	1,968	2,516	2,108
Bolivia :								
Exports of ore	Long ton	1,103	775	1,114	14,423	1,022		1,127
Copper content of ore exported .	*do.*					*576*		*548*

(a) *This figure is given as a revised figure in the official returns*

(b) *Monthly average of first quarter, 1926.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
COPPER—(*contd.*)								
Chile :								
Exports of ore	Long ton	2,042	13,595	7,602	77,921	2,844	8,109	8,961
Production of copper bar	do.	16,386	16,080	15,965	173,165	16,032	16,518	16,139
Exports of copper bar	do.	13,971	14,967	10,585	153,820	13,558	15,317	18,341
Peru :								
Smelter output	Long ton	4,312	3,973	3,822	38,428	4,101	3,066	3,790
Exports of ore (*a*)	do.	—	89	100	922	424	33	847
Exports of matte (*a*)	do.	69	80	59	951	51	86	—
Exports of concentrates (*a*)	do.	51	46	—	554	35	45	132
Exports of bars	do.	4,194	3,569	4,832	36,208	2,734	1,816	5,284
apan :								
Smelter output	Long ton	5,501	5,000	5,000	64,656	5,639	5,015	5,007
DIAMONDS								
BRITISH EMPIRE								
Gold Coast :								
Exports	Metric carat	12,320	—	12,856	77,314	20,995	22,663	
Southern Rhodesia :								
Production	Metric carat	46	(*b*) 13	(*b*) 13	189	3	—	—
Exports	do.	—	25	—	292			
South-West Africa Territory :								
Exports	Metric carat	45,912	44,250	44,592	515,090			
Union of South Africa :								
Production	Metric carat	216,667	200,194	214,892	2,430,128	221,898	201,593	230,448
Exports	do.	127,530	429,527	227,799	2,591,239			

Canada :								
Imports of unset diamonds .	£	48,673	66,178	40,376	587,693	56,892	82,890	83,843
Imports of diamond dust or bort and black diamonds for borers	£	741	15,389	1,757	107,869	11,310	24,266	5,944
British Guiana :								
Exports.	Metric carat	18,903	19,394	21,121	193,198	13,586	7,030	5,411
Ceylon :								
Imports.	Metric carat	*£240*	—	6	1,052	5	—	—
India :								
Total imports from overseas .	£	60,471	56,752	37,460	536,285	30,399	47,644	62,084
FOREIGN COUNTRIES								
United States :								
Total imports of unset diamonds for glaziers, engravers and miners	Metric carat	3,507	4,638	7,311	46,556	4,810	2,697	4,619
Total imports of uncut diamonds	do.	16,617	25,479	10,916	171,842	15,264	20,092	24,358
Total imports of cut diamonds, unset	do.	47,307	45,177	38,457	513,783	61,969	72,384	47,866
Total imports of diamond dust.	£	38,938	11,205	46,830	157,482	8,802	7,736	6,244
GOLD								
PRODUCTION IN BRITISH EMPIRE								
Anglo-Egyptian Sudan (exports of bullion)	Troy oz.	880	420	1,094	8,745	826	756	
Gold Coast	Fine troy oz.	15,670	15,000	15,600	190,930	15,800	14,420	14,852
Northern Rhodesia	Fine troy oz.	—	197	—	1,249	172	—	60
Southern Rhodesia	Fine troy oz.	48,896	50,364	49,307	581,504	48,967	46,026	46,902
Swaziland	Troy oz.				1,309			

(*a*) *Copper is also contained in mixed ores, etc., exported.* (*b*) *Monthly average of November and December.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
GOLD—(*contd.*)								
Union of South Africa:								
Total production	Fine troy oz.	815,402	791,216	781,071	9,597,592	799,509	753,960	834,286
By districts:								
Witwatersrand	do.	792,884	769,445	758,771	9,341,048	777,456	731,693	808,819
Other Transvaal	do.	22,518	21,770	22,300	256,525	22,053	22,267	25,467
Natal	do	—	1	—	19	—	—	—
Canada (Ontario):								
Total crude bullion produced (*a*)	Troy oz	113,880	112,930	129,830	(*b*)1,465.774	121,998	120,351	138,725
By districts:								
Porcupine	do.	91,613	90,702	105,072	1,204,040	94,174	95,834	113,877
Kirkland Lake	do.	22,261	22,223	24,746	261,473	27,824	24,517	24,848
Miscellaneous	do.				261			
British Guiana (exports)	Troy oz.	758	522	813	6,974	42	979	—
Federated Malay States:								
Pahang (exports)	Troy oz.	917	974	1,899	12,496	—	879	793
Perak	do.	81	40	30	1,659	34	66	121
India	Fine troy oz.	32,858	31,499	33,821	392,874	31,687	30,050	.
Australia:								
New South Wales	Fine troy oz.	1,043	1,015	1,427	19,422	1,497	1,226	1,154
Victoria	do.	7,096	3,376	1,104	47,296	1,914	3,685	4,599
Queensland	do.	1,067	6,604	1,337	44,332	604	488	466
Western Australia	do.	38,663	35,099	44,237	441,252	29,302	34,685	30,628
Tasmania	do.	(*c*) 352	(*c*) 352	(*c*) 352	3,524	(*d*) 356	(*d*) 356	(*d*) 356
Commonwealth	do.				556,000			
New Zealand (exports)	Troy oz.	12,593	9,919	5,631	114,696	5,015	8,582	13,906

Production in Foreign Countries								
France (gold ores)	Long ton	4,841	4,319	4,865	56,709	5,199	5,313	6,110
Italy (refinery production)	Troy oz.				2,250			
Russia	Fine troy oz.				735,000			
Belgian Congo (Kilo Moto)	Troy oz.				115,901			
Madagascar (exports)	Troy oz.	(c) 982	(c) 982	(c) 982	6,336			
Mexico	Fine troy oz.	73,881	64,043	67,483	788,993	54,430	70,376	73,624
United States	Fine troy oz.				2,376,514			
Bolivia:								
Quantity of gold exported	Troy oz	—	—	96	386	—		64
Value of gold exported	£	—	—	396	1,274	—		114
Brazil	Fine troy oz.				116,000			
Ecuador	Fine troy oz.				43,000			
Japan	Fine troy oz.				280,000			
Philippine Islands (exports of bullion)	Troy oz	12,886	14,800	13,614	159,580	13,194	14,299	12,141
GYPSUM								
British Empire								
Canada:								
Production of gypsum	Long ton				652,709			
Exports of crude gypsum	do	71,339	60,089	58,576	476,469	39,375	2,054	2,455
Imports of crude gypsum	do	548	756	75	3,958	104	131	83
Imports of ground gypsum	do.	5	16	13	105	29	21	11
Exports of plaster of Paris, etc.	do	315	459	532	5,038	99	714	3,972
Imports of plaster of Paris, etc.	do.	339	292	247	3,902	120	123	280

(*a*) *Including a small quantity of silver* (*b*) *Gold content of ore produced in the Dominion for 1925 was 1,740,386 fine troy ounces.*
(*c*) *Monthly average of fourth quarter, 1925.* (*d*) *Monthly average of first quarter, 1926.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
GYPSUM—(*contd.*)								
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.:								
Exports of crude gypsum	Long ton	122	428	45	2,892	290	51	342
Imports of crude gypsum	do.	6,711	7,957	5,518	85,644	8,578	9,426	10,416
Exports of ground gypsum	do.	526	282	352	7,623	360	242	852
Imports of ground gypsum	do.	2,234	3,368	3,022	32,774	2,274	3,816	4,227
Czechoslovakia:								
Imports of crude gypsum / Imports of calcined gypsum	Long ton	5,031	4,835	3,563	50,188	288 / 1,475	1,022 / 2,263	1,599 / 3,067
France:								
Exports of plaster of Paris	Long ton	16,426	20,592	12,473	206,425	14,676	20,895	16,790
Imports of plaster of Paris	do.	476	816	547	13,912	487	488	996
Germany:								
Exports of gypsum and gypsum-superphosphate	Long ton	9,350	9,173	6,402	109,021	5,551	6,099	7,747
Imports of gypsum and gypsum-superphosphate	do.	680	544	140	7,473	84	331	489
Italy:								
Exports of gypsum	Long ton	34	55	80	1,186	15	452	123
Imports of gypsum	do.	210	282	195	2,922	159	326	209
Production of alabaster	do.				14,000			
Exports of crude alabaster	do.	223	355	230	3,078	91	147	116
Netherlands:								
Imports of gypsum	Long ton	1,604	1,010	1,279	18,781	1,211	1,422	1,815
United States:								
Total imports of crude gypsum	Long ton	64,299	59,235	73,536	566,449	19,566	1	5,865

IRON ORE								
British Empire								
United Kingdom:								
Total production in Great Britain	Long ton	(a) 826,373	(a) 826,373	(a) 826,373	10,142,855			
By kinds:								
West coast haematite (non-phosphoric)	do.	(a) 82,055	(a) 82,055	(a) 82,055	951,873			
Jurassic ironstones:								
Lower Lias	do.	(a) 164,849	(a) 164,849	(a) 164,849	1,988,268			
Middle Lias: Cleveland	do	(a) 176,484	(a) 176,484	(a) 176,484	2,284,186			
Other	do.	(a) 123,259	(a) 123,259	(a) 123,259	1,527,400			
Inferior Oolite	do.	(a) 239,029	(a) 239,029	(a) 239,029	2 948,413			
Coal measure ironstones	do.	(a) 30,321	(a) 30,321	(a) 30,321	342,998			
Other haematite, brown ore, etc.	do.	(a) 10,376	(a) 10,376	(a) 10,376	99,717			
Total imports	do.	318,118	339,222	365,908	4,374,755	386,781	421,544	464,823
Exports	do.	169	279	180	2,582	88	196	359
Southern Rhodesia:								
Production	Long ton	271	218	215	1,046	223	437	—
Union of South Africa:								
Production	Long ton	—	—	—	—	—	612	1,051
Canada:								
Imports	Long ton	144,287	104,044	94,526	926,094	18,251	274	976
Exports	do.	683	54	36	3,932	58	36	—
British Malaya:								
Exports	Long ton	23,042	19,690	24,728	271,995	16,376	17,412	23,117
Australia (Queensland):								
Production	Long ton	—	—	—	(c) 303	(b) 544	(b) 544	(b) 544
Foreign Countries								
Austria:								
Production in Styria and Carinthia	Long ton	79,027	85,320	86,606	1,003,984	96,752	115,597	108,969

(a) *Monthly average of fourth quarter, 1925.* (b) *Monthly average of first quarter, 1926.*
(c) *Iron ore produced in the Commonwealth during 1925 was 738,686 long tons.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
IRON ORE—(*contd.*)								
Belgium–Luxemburg E.U.:								
Imports	Long ton	703,503	698,561	713,076	8,744,363	652,354	812,739	1,020,883
Exports	do.	137,575	134,865	116,568	1,763,644	152,172	129,346	142,587
Czechoslovakia:								
Imports	Long ton	180,276	146,457	34,531	812,949	19,769	13,844	45,017
Exports	do.	6,498	8,717	10,992	81,030	12,714	11,257	13,526
France:								
Total extracted	Long ton	3,218,314	2,981,882	3,079,542	35,166,783	3,088,084	2,964,808	3,277,734
Of which, merchantable ore:								
Non-phosphoric	do.	19,906	17,187	21,987	241,805	18,435	18,407	20,366
Slightly phosphoric	do.	134,674	126,204	121,697	1,482,746	125,977	126,696	146,448
Phosphoric	do.	3,035,467	2,811,973	2,909,801	33,158,521	2,916,096	2,801,481	3,084,750
Exports	do.	664,942	655,936	580,663	9,078,408	600,499	843,659	944,689
Imports	do.	136,689	78,471	76,410	1,218,142	31,154	162,939	98,248
Germany:								
Imports	Long ton	749,622	633,408	602,030	11,354,546	510,486	661,313	587,950
Exports	do.	35,273	14,931	11,782	198,500	13,953	22,876	15,511
Italy:								
Production	Long ton				(*a*) 466,600			
Imports	do.	54,270	19,288	12,893	304,314	25,095	21,964	27,008
Luxemburg:								
Production	Long ton				6,564,860			
Norway:								
Exports	Long ton	5,278	27,387	9,453	417,836	14,734	8,116	12,078
Russia:								
Production	Long ton	268,000	229,000	224,000		235,000		
Sweden:								
Exports	Long ton	863,132	690,797	368,950	8,651,249	411,857	437,142	537,924

Switzerland :								
Exports	Long ton	2,106	3,204	1,429	58,572	2,128	1,684	1,589
Imports	do.	3,581	4,215	2,163	41,750	740	152	1,848
Algeria :								
Total extracted	Long ton	150,410	141,584	150,198	1,772,228	(*d*) 120,134	(*d*) 120,134	(*d*) 120,134
Of which, merchantable ore :								
Non-phosphoric	do.	149,525	141,346	146,396	1,731,690			
Slightly phosphoric	do.	—	—	2,951	25,666			
Tunis :								
Production (all non-phosphoric)	Long ton	48,000	52,000	59,000	711,000			
Cuba :								
Production	Long ton				900,000			
United States :								
Production	Long ton				61,307,997 (*b*)			
Shipments from mines through Upper Lake Ports	do.	7,004,000	4,258,000	7,000	54,075,000	—	—	—
Total imports	do.	204,317	246,403	240,049	2,190,697	202,332	160,172	184,122
Exports	do.	105,526	42,266	1,128	630,700	888	819	858
Chile :								
Exports	Long ton	1[illegible]7,890	128,628	151,937	1,214,258	121,472	87,938	—
LEAD								
BRITISH EMPIRE								
United Kingdom :								
Lead content of ore produced in Great Britain	Long ton	(*d*) 1,057	(*d*) 1,057	(*d*) 1,057	12,463			
Smelter output	do.	(*c*) 355	(*c*) 355	(*c*) 355	4,735			
Total imports of pig-lead and sheets	do.	25,758	19,943	30,132	275,494	26,898	22,632	19,148
Re-exports of pig-lead and sheets	do.	1,717	1,467	2,212	14,474	990	292	648
Exports of pig-lead	do.	412	431	373	6,428	669	363	331
Exports of wrought lead	do.	466	595	497	6,634	624	614	823

(*a*) *Excluding manganiferous ore.* (*b*) *Excluding ore containing 5 per cent. or more of Mn.* (*c*) *Monthly average of second half-year, 1925.*
(*d*) *Monthly average of fourth quarter, 1925.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
LEAD—(*contd.*)								
Northern Rhodesia :								
Smelter output . .	Long ton	384	198	259	2,993	80	—	—
Exports of pig-lead . .	do.	472	33	313	2,770			
Southern Rhodesia :								
Lead content of ore produced .	Long ton	—	4	—	4	—	—	—
South-West Africa Territory :								
Exports of pig-lead . .	Long ton	—	445	—	1,525			
Union of South Africa :								
Lead content of sales and shipments of ore :								
Transvaal	Long ton	100	1	6	1,602	3	8	6
Cape of Good Hope . .	do.	14	14	21	127	14	7	21
Smelter output in Transvaal .	do.	90	100	—	1,205			
Canada :								
Lead content of ore produced .	Long ton				113,039			
Lead content of ore exported .	do.	1,088	819	638	16,743	1	—	(*d*)
Smelter output . . .	do.	9,930	9,674	9,616	110,962	10,661	9,709	9,659
Exports of pig-lead . .	do.	6,775	5,708	7,934	71,487	5,883	6,981	13,375
India :								
Lead content of ore produced in Burma	Long ton	(*a*) 5,980	(*a*) 5,980	(*a*) 5,980	66,500	(*c*) 6,778	(*c*) 6,778	(*c*) 6,778
Refinery output in Burma .	do.	4,001	4,393	4,500	47,665	4,700	4,725	4,780
Exports of pig-lead overseas .	do.	2,889	3,698	3,478	41,137	5,150	1,421	8,086
Total imports of wrought lead from overseas . . .	do.	152	172	154	2,394	212	237	251

Australia :								
Lead content of ore produced in (*b*) :								
Queensland	Long ton	(*a*) 361	(*a*) 361	(*a*) 361	4,836	(*c*) 190	(*c*) 190	(*c*) 190
Tasmania	do.	(*a*) 510	(*a*) 510	(*a*) 510	5,526	(*c*) 414	(*c*) 414	(*c*) 414
Exports of ore and concentrates overseas from :								
Victoria (ore)	do.	—	—	—	86	—	—	—
Western Australia (concentrates)	do.	581	124	496	4,823	—	672	—
South Australia (concentrates)	do.	—	7,620	5,026	29,877	—	2,001	—
Exports of silver-lead ore and concentrates overseas from :								
New South Wales	do.	142	16	135	986	—	106	—
Western Australia	do.	—	43	44	87	—	—	—
Queensland	do.	—	—	264	1,162	268	15	1,000
South Australia	do.	—	749	—	770	—	—	—
Tasmania	do.	—	—	2,458	7,117	—	834	101
Smelter output in Commonwealth	do.	13,980	14,000	15,840	148,880	11,481	10,104	9,646
Exports overseas of pig-lead from:								
New South Wales	do.	5,808	4,750	4,616	73,796	5,464	3,969	10,377
Queensland (silver-lead bullion)	do.	—	—	—	3,037	—	—	—
South Australia	do.	8,147	3,766	1,829	43,652	7,259	10,005	998
Value of matte and pig-lead exported from Commonwealth	£	783,264	314,961	325,245	4,718,275	457,670	509,107	392,853
FOREIGN COUNTRIES								
Austria :								
Carinthia :								
Production of lead ore	Long ton	130	627	557	5,527	356	2	351
Production of wulfenite	Cwt.	77	22	4	382	—	—	2
Smelter output	Long ton	1,031	597	508	5,322	418	373	522
Tyrol : Production of lead ore	do.	640	640	640	7,424	522	494	555

(*a*) *Monthly average of fourth quarter, 1925.* (*b*) *Lead content of ore produced in the Commonwealth during 1925 was 184,606 long tons.* (*c*) *Monthly average of first quarter, 1926.* (*d*) *Less than ½ ton.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
LEAD—(*contd.*)								
Belgium-Luxemburg E.U.:								
Imports of ore	Long ton	4,215	3,278	3,989	34,030	5,159	6,128	17,733
Exports of ore	do.	6	1	27	396	78	55	130
Imports of pig-lead and scrap .	do	889	2,225	1,587	11,140	1,243	449	940
Exports of pig-lead and scrap .	do.	2,158	1,737	4,107	14,376	1,624	1,909	2,426
Imports of wrought lead, etc. .	do.	28	43	27	1,103	22	34	22
Exports of wrought lead, etc. .	do.	770	733	1,197	9,681	560	726	967
Czechoslovakia:								
Imports of pig-lead and scrap .	Long ton	1,101	534	641	5,994	405	425	690
France:								
Production of lead ore . .	Long ton	1,264	898	2,268	16,417	2,389	1,750	(*c*) 843
Imports of ore	do.	1,699	184	1,528	30,400	6,549	405	1,868
Exports of ore	do.	732	1,750	927	8,623	392	725	539
Imports of pig-lead and scrap .	do.	5,675	5,410	4,253	70,325	3,688	5,783	7,248
Exports of pig-lead and scrap .	do.	360	155	706	2,849	87	74	121
Germany:								
Imports of ore	Long ton	2,935	12,878	3,729	34,705	3,006	5,176	4,393
Exports of ore	do.	445	219	450	7,174	397	1,012	681
Smelter output	do.				46,000			
Imports of pig-lead and scrap .	do.	7,552	6,765	5,147	135,531	7,398	5,135	4,371
Exports of pig-lead and scrap .	do	1,555	3,059	1,836	15,087	1,199	1,586	2,096
Exports of wrought lead . .	do.	287	205	381	3,545	373	376	482
Italy:								
Production of ore	Long ton				48,060			
Imports of ore, including argentiferous	do.	318	1,259	14	6,980	514	720	4
Exports of ore, including argentiferous	do.	760	566	861	12,519	3,310	686	143
Smelter output	do.	2,021	2,127	2,838	22,900	2,330	2,146	1,543

Imports of pig lead and scrap(*a*)	Long ton	1,470	1,289	2,446	26,183	947	2,907	1,989
Exports of pig-lead and scrap(*a*)	do	6	7	23	8,532	14	16	—
Netherlands:								
Imports of pig-lead and scrap	Long ton	1,469	1,258	794	11,875	1,413	1,219	1,479
Imports of wrought lead	do.	170	150	154	2,175	300	112	150
Spain and Tunis (*e*):								
Smelter output	Long ton	10,025	9,564	11,000	114,680	9,466	8,913	10,369
Upper Silesia:								
Production of ore	Long ton	2,237	2,569	2,018	19,013			
Smelter production	do.	2,395	2,151	1,652	20,980			
Algeria:								
Production of ore	Long ton	964	3,557	1,021	15,369	(*d*) 1,579	(*d*) 1,579	(*d*) 1,579
Tunis:								
Production of ore (see Spain)	Long ton	3,198	3,247	3,719	36,494			
Mexico:								
Lead content of ore produced	Long ton	14,297	10,579	15,881	169,006	6,223	24,987	19,198
Smelter output (*b*)	do.	15,909	14,594	13,631	181,491	14,644	13,269	17,217
United States:								
Lead content of ore produced	Long ton	42,332	43,101	45,252	493,599	41,346	39,064	41,347
Smelter output	do	47,257	43,955	46,265	654,888	45,354	42,504	46,724
Lead content of total imports of:								
Ore and matte	do	3,650	3,073	3,394	39,715	3,535	4,508	5,051
Bullion and base bullion	do.	3,383	6,356	8,673	63,059	3,820	4,047	1,977
Pig-lead and bars	do	—	76	625	5,713	700	164	392
Scrap and alloys	do	64	26	10	556	50	4	7
Type metal and antimonial lead	do	25	722	750	1,924	64	66	937
Exports of pig-lead, bars, etc., produced from:								
Domestic ore	do.	111	836	986	4,425	25	54	1,188
Foreign ore	do.	4,353	4,518	4,632	87,428	5,444	2,253	2,115

(*a*) *Including antimonial lead*
(*b*) *Including lead produced in the United States from Mexican ore, which averaged 2,500 long tons per month during 1924.*
(*c*) *Excluding 1,807 long tons of mixed lead and zinc ore.*
(*d*) *Monthly average of first quarter, 1926.*
(*e*) *Incomplete figures.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
LEAD—(*contd.*)								
Argentina :								
Smelter output	Long ton				7,700			
Bolivia :								
Exports of ore, etc.	Long ton	3,250	3,337	2,526	36,246	2,778		2,837
Lead content of ore, etc., exported	do.					*1,669*		*1,617*
MANGANESE ORE								
British Empire								
United Kingdom :								
Total imports	Long ton	6,661	12,072	13,119	278,620	15,555	23,179	19,310
Re-exports	do.	—	—	—	1,370	1,250	50	43
Gold Coast :								
Exports	Long ton				330,000			
Union of South Africa (Transvaal) :								
Sales and shipments	Long ton	58	29	11	448	—	—	—
Canada :								
Exports	Long ton	66	—	37	434	—	—	—
India :								
Exports overseas	Long ton	41,727	33,654	48,210	604,198	45,155	33,671	41,681
Foreign Countries								
Belgium-Luxemburg E.U. :								
Imports	Long ton	12,449	13,252	7,096	196,895	18,280	16,560	16,972
Czechoslovakia :								
Imports	Long ton	19	31	418	667	581	529	698

France :								
Production	Long ton	261	239	252	3,134	247	260	248
Imports	do	43,255	34,830	52,898	462,015	53,316	42,870	35,506
Exports	do.	300	269	335	1,696	180	255	184
Germany :								
Imports	Long ton	4,112	4,769	3,003	196,171	16,135	8,537	5,659
Exports	do.	315	—	10	360	—	98	44
Italy :								
Production	Long ton				12,565			
Imports	do.	2,730	6,425	6,302	67,659	4,509	285	295
Exports	do	162	147	173	2,553	70	158	39
Russia :								
Production in Tchiaturi	Long ton	62,982	61,866	66,892	(*a*)			
Tunis :								
Production	Long ton	31	49	—	1,702			
United States :								
Total imports	Long ton	128	1,021	4,563	12,745	4,500	174	237
Brazil :								
Exports	Long ton	2',915	35,917	23,122	306,870	25,361	38,010	31,786
MICA								
BRITISH EMPIRE								
United Kingdom :								
Total imports	Long ton	303	157	188	2,688	116	104	159
Re-exports	do.	136	101	88	1,383	62	67	66
Southern Rhodesia :								
Production	Long ton	11	4	11	130	4	4	21
Exports	do.	8	13	7	135			
Union of South Africa :								
Production	Long ton	123	(*b*)	80	1,439	18	73	63
Exports	do	—	43	—	839			

(*a*) *Production in Russia during the year ended 30th September, 1925, was 512,721 long tons.* (*b*) *86 lb.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
MICA—(*contd.*)								
Canada (*d*) :								
Exports of :								
Scrap and waste . . .	Long ton	693	973	423	4,457	92	200	206
Rough cobbed and thumb-trimmed mica . .	do.	—	5	3	25	—	(*a*)	(*a*)
Splittings	do.	16	11	20	206	41	40	20
India :								
Exports of blocks overseas .	Long ton	21	66	37	748	22	148	57
Exports of splittings overseas .	do.	255	343	303	4,237	340	348	423
FOREIGN COUNTRIES								
Germany :								
Imports	Long ton	74	52	33	1,223	94	72	70
France :								
Imports	Long ton	110	23	46	736	56	71	85
Exports	do.	21	76	10	402	21	37	36
Madagascar :								
Exports of muscovite . .	Long ton	(*b*) 2	(*b*) 2	(*b*) 2	36			
Exports of phlogopite, etc. .	do.	(*b*) 12	(*b*) 12	(*b*) 12	226			
United States :								
Exports	Long ton	67	76	56	1,081	72	73	45
Imports	do.	17	26	20	280	23	32	16

NICKEL								
British Empire								
Canada :								
Production in Ontario :								
Nickel in matte exported .	Long ton	(b) 1,624	(b) 1,624	(b) 1,624	14,580	(c) 1,300	(c) 1,300	(c) 1,300
Nickel	do.	(b) 1,543	(b) 1,543	(b) 1,543	14,337	(c) 1,374	(c) 1,374	(c) 1,374
Nickel oxide and salts . .	do.	(b) 292	(b) 292	(b) 292	5,256	(c) 243	(c) 243	(c) 243
Exports :								
Nickel content of ore, matte or speiss	do.	976	2,800	2,167	17,950	978	621	3,252
Nickel	do.	1,700	1,992	1,812	13,445	1,093	757	789
Imports of nickel and nickel-silver	do.	14	20	10	473	81	22	45
India :								
Total imports of nickel and alloys from overseas . . .	Long ton	93	77	82	969	125	59	87
Foreign Countries								
Belgium-Luxemburg E.U. :								
Imports of wrought nickel .	Long ton	8	20	120	442	19	13	13
Exports of wrought nickel .	do.	105	77	99	1,446	311	92	170
Imports of unwrought nickel and scrap	do.	2	530	198	2,617	212	183	9
Exports of unwrought nickel and scrap	do.	20	39	56	584	110	122	50
France :								
Imports of ore, matte and speiss	Long ton	441	276	5	1,548	301	—	263
Imports of nickel and nickel-silver	do.	132	98	78	901	141	122	115
Exports of nickel and nickel-silver	do.	49	103	54	514	21	39	31

(a) *Less than ½ ton.* (b) *Monthly average of fourth quarter, 1925.* (c) *Monthly average of first quarter, 1926.*
(d) *Production of mica during 1925 was 3,153 long tons.*

Particulars.	Unit.	October 1925.	November 1925	December 1925.	Year 1925.	January 1926	February 1926.	March 1926.
NICKEL—(*contd.*)								
Germany :								
Imports of ore	Long ton	—	83	144	2,753	182	65	30
Imports of unwrought nickel, scrap and coin	do.	78	122	33	2,481	22	76	124
Exports of unwrought nickel, scrap and coin	do.	69	19	56	659	102	61	34
Netherlands :								
Imports of unwrought and wrought nickel, etc.	Long ton	54	59	46	508	63	44	24
United States :								
Total imports of ore and matte	Long ton	570	380	693	4,425	730	802	566
Total imports of nickel and nickel-silver	do.	1,904	2,065	1,697	14,302	1,468	722	692
Exports of nickel-silver	do.	14	14	69	220	102	117	111
New Caledonia :								
Exports of ore	Long ton				12			
Exports of matte	do.				4,364			
PETROLEUM, INCLUDING SHALE-OIL								
British Empire								
Trinidad :								
Production	Long ton	58,507	58,140	56,965	626,644	59,362	51,264	55,564
Exports :								
Crude petroleum	Gallon	2,464	550,277	5,764	10,372,810	2,225,566	1,040	2,114,673
Gasoline	do.	469,923	2,080,357	311,968	13,348,862	326,412	376,476	2,308,699
Kerosene	do.	79,460	40,359	95,381	2,917,810	94,658	15,987	95,600
Fuel-oil	do.	10,442,097	12,783,251	11,898,863	85,253,840	2,746,528	8,204,757	18,311,530
Lubricating oil	do.	926	1,162	93	31,535	—	40	176

India :								
Production	Long ton				1,193,779			
Exports overseas :								
Benzine and other light oils .	Gallon	—	—	2,560,000	12,822,072	—	392	2,595
Other mineral oils . .	do.	11,909	7,066	13,748	137,242	6,628	10,989	11,455
Sarawak :								
Production	Long ton				603,270			
FOREIGN COUNTRIES								
France :								
Production	Long ton	5,365	3,614	5,047	67,753	5,790	5,105	6,755
Germany :								
Production	Long ton				77,833			
Italy :								
Production	Long ton				5,067			
Poland :								
Production	Long ton	67,703	67,800	67,800	798,862	67,715	60,703	68,811
Rumania :								
Total production . . .	Long ton	232,699	200,280	194,368	2,274,535	221,665	221,329	244,344
By fields :								
Prahova	do.	187,029	155,147	150,820	1,821,962	164,842	170,113	187,749
Dambovitza . . .	do.	29,724	31,391	30,175	291,808	42,817	38,085	41,959
Other fields . . .	do.	15,946	13,742	13,373	160,765	14,006	13,131	14,636
Russia :								
Total production . . .	Long ton	647,000	629,000	646,000	7,500,000			
Of which, Baku . . .	do.	434,830	442,578	429,810	4,900,000	424,028	399,265	432,011
Algeria :								
Production	Long ton	159	147	149	1,791			
Egypt :								
Production	Long ton	13,066	12,802	16,303	175,069	12,537	11,971	15,202
Mexico :								
Production (*a*) . . .	Long ton	1,144,066	1,230,092	1,320,369	16,502,100	1,359,823		

(*a*) *Converted at the rate of 7 barrels = 1 long ton.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
PETROLEUM, INCLUDING SHALE-OIL—(*contd.*)								
United States (*a*) (*b*) :								
Total production	Long ton	9,193,100	8,779,900	8,706,100	107,978,900	8,524,300	7,794,900	8,667,000
By fields :								
Appalachian	do.	334,900	307,600	320,100	3,895,800	309,700	302,600	341,600
Lima-Indiana	do.	24,700	21,700	22,400	303,000	22,400	22,600	25,600
Illinois-S.W. Indiana . .	do.	104,400	98,200	98,400	1,214,700	98,400	93,600	111,300
Mid-Continent	do.	5,010,100	4,812,100	4,719,700	60,138,000	4,542,700	4,137,100	4,637,100
Gulf Coast	do.	395,300	363,400	362,200	4,494,000	390,600	370,300	380,400
Rocky Mountain . .	do.	464,400	448,900	433,300	5,055,100	436,200	416,700	481,600
California	do.	2,859,300	2,728,000	2,750,000	32,878,300	2,724,300	2,452,000	2,689,400
By class :								
Light crude (24° (0·910) and lighter)	do.	6,474,700	6,226,600	6,138,000	77,169,700	6,160,700	5,651,500	6,288,000
Heavy crude (heavier than 24° A.P.I.)	do.	2,718,400	2,553,300	2,568,000	30,809,200	2,363,600	2,143,400	2,379,000
Argentina :								
Production	Long ton				930,515			
Colombia :								
Production	Long ton				70,000			
Peru :								
Production	Long ton				1,600,000			
Venezuela :								
Production	Long ton	(*c*) 322,500	342,100	377,400	2,950,856	385,894	353,528	403,014
Dutch East Indies :								
Production	Long ton				3,140,000			
Japan :								
Production	Long ton				237,000			
Persia :								
Production	Long ton				4,578,428			

PHOSPHATES								
BRITISH EMPIRE								
United Kingdom :								
Total imports of phosphate-rock and phosphate of lime . .	Long ton	15,934	56,206	32,165	333,179	41,512	22,105	26,970
Exports of superphosphates .	do.	337	55	585	18,671	1,067	1,796	1,690
Canada :								
Imports of phosphate-rock .	Long ton	—	36	—	12,502	—	—	130
Imports of superphosphates .	do.	1,514	4,007	6,090	56,700	4,463	6,392	11,065
Ceylon :								
Imports of superphosphates .	Long ton	321	465	675	3 761	560	512	614
New Zealand :								
Total imports of phosphate-rock, superphosphates and fertilisers	Long ton	4,999	5,960	12,578	174,994	4,965	2,394	21,515
FOREIGN COUNTRIES								
Belgium–Luxemburg E.U. :								
Imports of phosphate-rock .	Long ton	28,199	50,747	44,864	321,126	18,396	33,359	38,052
Exports of phosphate-rock .	do	9,343	11,479	12,339	65,403	11,297	5,913	7,092
Imports of superphosphates .	do.	933	18	741	26,662	2,766	6,747	10,814
Exports of superphosphates .	do	11,165	12,439	13,751	173,408	25,779	33,322	57,930
Czechoslovakia :								
Imports of phosphate-rock .	Long ton	18,247	20,316	10,499	115,390	6,579	2,646	8,712
Imports of superphosphates .	do.	1,970	60	—	14,274	39	4,250	7,109
Exports of superphosphates .	do.	459	2	—	4,731	20	588	469
Denmark :								
Total imports of phosphate-rock	Long ton	5,229	11,872	10,557	124,794	17,845	9,724	11,072
Total imports of superphosphates	do.	1,831	441	11,452	144,975	34,208	43,106	22,772

(a) *Converted at the rate of 7 barrels = 1 long ton.*

(b) *Figures refer to petroleum transported from the fields. The production, including fuel consumed and stocked, would be about 109,000,000 long tons for the year 1925.*

(c) *Shipments.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
PHOSPHATES—(*contd.*)								
France:								
Imports of phosphate-rock	Long ton	90,338	112,491	124,319	1,274,892	110,183	114,115	154,558
Imports of superphosphates	do.	1,078	409	537	21,927	200	584	749
Exports of superphosphates	do.	34,625	22,893	26,741	225,676	16,108	28,907	29,441
Germany:								
Imports of phosphate-rock	Long ton	22,858	18,413	39,848	392,954	28,455	42,834	29,350
Imports of superphosphates	do.	3,734	371	444	39,327	2,739	4,080	11,972
Exports of superphosphates	do.	3,053	837	3,633	45,007	7,769	6,904	18,945
Italy:								
Imports of phosphate-rock	Long ton	57,155	66,883	73,722	823,312	82,385	77,301	69,637
Netherlands:								
Imports of phosphate-rock	Long ton	12,981	30,991	11,999	324,150	43,956	28,473	28,667
Imports of superphosphates	do.	2,621	3,259	3,737	93,131	12,685	39,110	37,751
Exports of superphosphates	do.	27,609	17,067	27,619	377,257	41,464	37,579	50,793
Norway:								
Total imports of superphosphates	Long ton	106	585	300	21,665	1,330	5,219	9,853
Sweden:								
Imports of phosphate-rock	Long ton	33,007	—	—	144,074	4,558	14,016	19,268
Exports of superphosphates	do.	2,315	2,374	4,624	87,200	4,356	4,639	3,980
Algeria:								
Production of phosphate-rock	Long ton	54,134	60,352	59,909	705,114	(*b*) 55,160	(*b*) 55,160	(*b*) 55,160
Egypt:								
Exports of phosphate-rock	Long ton	—	—	—	65,292	6,188	8,983	10,894
Total imports of superphosphates	do.	13,838	15,898	7,881	54,906	2,466	98	492
Morocco:								
Sales of phosphates	Long ton				709,100			
Tunis:								
Production of phosphate-rock	Long ton	247,790	189,000	211,000	2,648,000			

United States :							
Exports of phosphate-rock .	Long ton	71,850	44,286	98,872	870,276	40,333	70,849	70,616
Exports of superphosphates .	do.	2,772	1,908	4,108	66,879	4,019	7,967	13,885
PLATINUM, &c.								
BRITISH EMPIRE								
Union of South Africa (Transvaal) :								
Production of crude platinum .	Troy oz	—	—	—	—	209	727	363
Sales and shipments of osmiridium	Troy oz	515	576	279	6,055	628	150	275
Canada (Ontario) :								
Production of platinum metals .	Troy oz	(a) 2,728	(a) 2,728	(a) 2,728	16,980	(b) 138	(b) 138	(b) 138
Canada :								
Platinum content of exports of concentrates, etc.. . .	Troy oz.	1	39	45	404	70	60	89
Exports of scrap . . .	do.	31	42	36	655	55	41	—
Australia :								
Victoria: Export overseas of osmiridium	Troy oz	417	456	547	2,004	—	214	128
Tasmania : Production of osmiridium	do	(a) 786	(a) 786	(a) 786	3,366	(b) 338	(b) 338	(b) 338
FOREIGN COUNTRIES								
United States :								
Production from placers . .	Troy oz.				343			
Imports of ore (platinum content)	do.					4	871	16
Exports of unwrought platinum	do.	1,326	1,592	1,337	16,234	2,487	1,392	1,112
Imports of unwrought platinum	do.	11,195	7,641	11,832	106,478	9,307	7,596	7,596
Imports of iridium, osmium, palladium, etc. . . .	do.	1,573	1,857	1,845	14,931	1,719	1,421	1,311

(a) *Monthly average of fourth quarter, 1925.* (b) *Monthly average of first quarter, 1926.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
PYRITES								
BRITISH EMPIRE								
United Kingdom:								
Production in Great Britain, including arsenical pyrites	Long ton	(a) 454	(a) 454	(a) 454	5,315			
Total imports, including cupreous pyrites	do.	18,362	17,074	29,880	275,322	25,173	23,944	33,475
Union of South Africa (Transvaal):								
Sales and shipments	Long ton	196	150	148	2,472	168	155	216
Canada:								
Production	Long ton				13,321			
FOREIGN COUNTRIES								
Austria:								
Production in Styria	Long ton	1,069	859	966	10,843	507	476	667
Czechoslovakia:								
Imports of pyrites	Long ton	37,872	29,830	34,415	253,464	4,083	3,264	15,677
Imports of pyrites waste						8,516	8,251	10,187
Exports of pyrites and waste	do.	—	262	670	1,207	466	251	625
France:								
Production	Long ton	17,209	15.795	14,665	194,736	14,589	15,204	15,164
Imports	do.	35,097	33,667	67,211	477,363	40,126	25,328	61,810
Germany:								
Imports of pyrites and other sulphur minerals	Long ton	80,015	87,969	96,910	917,630	46,140	51,892	69,684
Exports of pyrites and other sulphur minerals	do.	637	342	1,034	11,469	528	342	316

Italy :								
Production of iron pyrites .	Long ton				504,900			
Imports of iron pyrites . .	do.	12,994	26,741	2,736	193,165	9,991	10,494	15,012
Exports of iron pyrites . .	do.	13,411	16,047	11,153	170,762	9,839	4,532	11,851
Exports of cupreous pyrites .	do.	12	—	—	4,271	—	—	—
Netherlands :								
Imports of iron pyrites . .	Long ton	11,496	11,121	7,063	98,842	5,766	15,288	12,583
Norway :								
Exports of iron pyrites . .	Long ton	18,086	6,641	11,002	94,135	1,503	4,523	17,373
Exports of cupreous pyrites .	do.	51,345	42,372	21,789	435,878	34,134	28,488	50,214
Algeria :								
Production of iron pyrites .	Long ton	1,026	994	987	12,373			
United States :								
Production of iron pyrites .	Long ton				170,081			
Total imports (containing more than 25 per cent. sulphur) .	do.	7,700	26,458	6,228	276,385	63,210	26,979	14,923
QUICKSILVER								
Austria (Tyrol) :								
Production	Lb.	1,100	1,100	1,100	13,200	880	1,100	1,100
Czechoslovakia :								
Exports	Lb.	10,222	842	2,129	22,481	882	6,612	24,244
Italy :								
Production	Lb.				3,636,600			
Exports	do.	323,327	432,866	368,950	3,322,310	355,946	359,913	204,531
Rumania :								
Production	Lb.				7,879			
Mexico :								
Production	Lb.	3,584	4,302	14,913	85,331	6,010	5,768	6,709
United States :								
Production	Lb.				688,050			

(a) *Monthly average of fourth quarter, 1925.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
SILVER								
BRITISH EMPIRE								
Northern Rhodesia :								
Production	Fine troy oz.	—	27	—	(c) 5,267	21	—	11
Southern Rhodesia :								
Production	Fine troy oz.	10,360	9,904	9,144	152,705	8,244	7,678	7,684
Union of South Africa (Transvaal) :								
Sales and shipments in gold bullion	Fine troy oz.	78,091	78,041	75,374	934,254	78,567	74,589	82,691
Sales and shipments in other minerals	do.	22,430	—	—	225,815	—	—	—
Canada :								
Production in Ontario	Fine troy oz.	(a)767,870	(a)767,870	(a)767,870	10,217,315 (b)	(f) 774,116	(f) 774,116	(f) 774,116
Silver content of ore, concentrates, etc., exported	do.	422,070	263,395	367,639	4,754,915	103,658	250,634	490,682
Silver bullion exported	Troy oz.	838,804	1,236,122	2,021,989	14,316,797	850,972	1,275,122	1,723,122
India (Burma) :								
Production	Fine troy oz.	410,832	422,000	478,000	4,670,000	(f) 434,114	(f) 434,114	(f) 434,114
Australia :								
Production in :								
Queensland	Fine troy oz.	(a) 26,623	(a) 26,623	(a) 26,623	286,516	(f) 13,776	(f) 13,776	(f) 13,776
Western Australia (c)	do.	—	21,454	692	59,075	137	15,493	53
Tasmania	do.	(a) 66,806	(a) 66,806	(a) 66,806	730,194	(f) 48,102	(f) 48,102	(f) 48,102
Commonwealth	do.				10,211,615			
New Zealand :								
Exports of silver	Troy oz.	46,211	38,242	31,251	495,268	36,865	17,176	43,847

Production in Foreign Countries								
Germany:								
Production	Troy oz.				4,501,000			
Italy:								
Refinery production	Troy oz.				268,800			
Cuba:								
Production	Fine troy oz.				91,916			
Mexico:								
Production	Fine troy oz.	8,417,577	8,027,180	9,721,356	92,885,176	5,561,500	8,707,313	9,192,232
United States:								
Production	Fine troy oz.	4,933,000	4,898,000	4,931,000	65,722,720	5,163,000	5,043,000	5,225,000
Bolivia:								
Quantity of ore exported	Cwt.	14,601	18,582	22,646	223,214	9,829		30,574
Value of ore exported	£	55,554	50,142	56,313	577,085	42,412		63,347
Silver content of ore exported	*Troy oz.*					*379,466*		*497,843*
Chile:								
Exports of ore	Cwt.	8,434	722	1,411	15,023	—	274	489
Exports of silver bullion	Troy oz.	11,233	25,331	37,082	300,828	—	34,554	21,239
Ecuador:								
Production	Fine troy oz.				78,000			
Peru:								
Production	Fine troy oz.				20,888,400			
Exports of:								
Ore(*d*)	Cwt.	590	1,397	2,327	14,576	2,080	570	1,032
Concentrates(*d*)	do.	—	13,134	10,812	104,179	19,778	1,738	20,771
Sulphides(*d*)	do.	76	82	77	888	7	71	107
Silver bullion	Troy oz.	260,383	210,840	186,792	790,922	82,400	79 925	1,897
Silver scrap	do.	—	—	675	2,122	—	—	—
Japan:								
Production	Fine troy oz.				5,665,000			

(*a*) *Monthly average of fourth quarter, 1925.* (*b*) *The production for the Dominion was 20,003,970 fine troy ounces during 1925.*
(*c*) *Silver content of bars, slag, etc., exported from the State, not necessarily overseas.* (*d*) *Silver is also contained in ores of base metals exported.*
(*e*) *Including an adjustment for the period 1920–1924 inclusive.* (*f*) *Monthly average of first quarter, 1926.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
SULPHUR								
British Empire								
United Kingdom:								
Total imports	Long ton	6,306	7,260	7,793	109,795	5,221	9,481	11,816
Canada:								
Imports	Long ton	25,958	22,362	4,566	130,902	3,016	4,982	3,101
India:								
Total imports from overseas	Long ton	546	1,314	1,335	12,337	1,529	1,839	2,342
New Zealand:								
Total imports	Long ton	13	1,678	3	19,982	4,221	1,958	2,364
Foreign Countries								
Belgium–Luxemburg E.U.:								
Imports	Long ton	1,181	598	1,493	9,288	594	946	529
Exports	do.	317	311	328	3,345	344	225	373
Czechoslovakia:								
Imports	Long ton	288	624	661	4,845	272	426	745
Finland:								
Total imports	Long ton	6,552	5,944	1,680	31,924	758	551	6
France:								
Imports of crude sulphur	Long ton	28,870	26,245	52,103	446,326	34,531	65,687	42,013
Exports of crude sulphur	do.	2,473	1,396	1,382	13,820	1,755	243	2,117
Exports of refined sulphur	do.	613	588	438	16,523	1,390	2,621	2,058
Germany:								
Imports	Long ton	3,827	8,119	13,797	103,817	10,586	2,633	8,537
Exports	do.	16,944	5,119	2,846	56,818	5,303	2,788	3,015
Italy:								
Production of crude sulphur	Long ton				259,000	-		
Production of ground sulphur	do.				22,000			

Exports of crude lump sulphur	Long ton	6,965	5,475	4,789	94,323	13,304	4,734	1,199
Exports of crude ground sulphur	do.	166	315		18,462	—	99	4,675
Exports of refined lump sulphur	do.	97	1,317	3,535	33,735	741	5,308	2,006
Exports of refined ground sulphur	do.	469	490	451	32,525	296	821	3,157
Exports of flowers of sulphur .	do.	239	618	112	8,132	107	426	11,347
Norway:								
Total imports	Long ton	1,002	1,209	1,211	15,292	3,166	406	1,740
Sweden:								
Imports	Long ton	8,637	7,630	6,112	62,184	2,123	1,187	2,551
United States:								
Production	Long ton				1,409,240			
Exports of sulphur . .	do.	64,655	36,651	58,176	629,401	56,042	53,476	60,487
Exports of flowers of sulphur .	do.	276	204	271	2,849	151	235	1,034
Japan:								
Production of sulphur rock .	Long ton				46,000			
TIN								
BRITISH EMPIRE								
Great Britain:								
Tin content of ore produced .	Long ton	(a) 204	(a) 204	(a) 204	2,348			
Total imports of ores and concentrates	do.	5,866	4,793	5,196	64,138	8,052	4,670	4,042
Re-exports of ores and concentrates	do.	17	1	10	256	—	—	44
Exports of blocks, ingots, etc. .	do.	2,240	2,267	2,485	25,730	2,074	2,457	1,906
Total imports of blocks, ingots, etc.	do.	1,183	1,113	2,577	15,934	2,119	1,232	1,624
Re-exports of blocks, ingots, etc.	do.	541	467	1,579	9,508	1,481	1,182	373
Nigeria:								
Approximate tin content of ore produced	Long ton	662	706	674	6,377	585	572	566
Southern Rhodesia:								
Tin content of ore produced .	Long ton	—	—	7	17			

(a) *Monthly average of fourth quarter, 1925.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
TIN—(*contd.*)								
South-West Africa Territory :								
Exports of ore	Long ton	13	24	12	218			
Swaziland :								
Production	Long ton				277			
Union of South Africa (Transvaal) :								
Tin content of marketable products	Long ton	101	101	109	1,157	118	83	90
Federated Malay States :								
Total tin content of exports	Long ton	3,872	3,543	3,524	45,925	3,963	3,546	3,501
By class :								
Tin in ore	do.	3,288	2,996	2,947	38,567	3,415	3,087	3,025
Tin	do.	584	547	577	7,358	548	459	476
By State :								
Perak	do.	2,521	2,414	2,342	30,748	2,687	2,371	2,311
Selangor	do.	1,199	954	983	13,104	1,100	1,021	994
Negri Sembilan	do.	—	—	—	3	—	—	
Pahang	do.	152	175	199	2,070	176	154	(b) 196
India :								
Tin content of ore produced	Long ton				1,300			
Exports of tin ore overseas	do.	174	203	154	1,887	157	165	192
Exports of tin overseas	do.	50	—	100	353	—	—	44
Australia :								
Tin concentrates produced in (*c*) :								
Queensland :								
Lode	Long ton	(*a*) 88	(*a*) 88	(*a*) 88	674	(*d*) 65	(*d*) 65	(*d*) 65
Alluvial	do.	(*a*) 24	(*a*) 24	(*a*) 24	335	(*d*) 18	(*d*) 18	(*d*) 18
Tasmania (tin content)	do.	(*a*) 125	(*a*) 125	(*a*) 125	1,130	(*d*) 67	(*d*) 67	(*d*) 67
Western Australia (*e*)	£	3,190	520	1,315	15,392	650	—	(*d*) 1,450

Exports of refined tin overseas from :								
New South Wales . .	Long ton	186	176	193	1,560	106	119	118
Victoria	do.	25	23	35	188	1	—	—
Exports of tin clippings overseas from :								
New South Wales . .	do.	—	97	208	1,036	89	210	211
Victoria	do.	163	47	605	2,264	90	287	468
Queensland	do.	—	175	7	349	35	—	115
South Australia . . .	do.	—	—	—	28	—	32	20
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports of ore	Long ton	101	335	—	1,369	205	33	34
Imports of unwrought tin and scrap	do.	92	68	78	1,128	85	81	85
Exports of unwrought tin and scrap	do.	124	101	116	748	15	43	142
Czechoslovakia :								
Imports of crude tin, tin alloys and scrap	Long ton	184	148	115	1,516	165	99	82
France :								
Production of tin-tungsten ore .	Long ton	590	472	594	1,658	207	460	—
Germany :								
Imports of ore	Long ton	221	16	83	1,677	82	—	126
Imports of crude tin and scrap.	do.	962	984	652	12,736	617	602	541
Exports of crude tin and scrap.	do.	270	294	266	2,724	270	313	338
Exports of tin-foil . . .	do.	23	24	22	257	36	27	42
Netherlands :								
Imports of crude tin and scrap .	Long ton	89	32	104	1,174	115	89	68
Belgian Congo :								
Production of tin ore . .	Long ton				1,500			

(a) *Monthly average of fourth quarter, 1925.* (b) *79 lb.* (c) *Tin content of ore produced in the Commonwealth during 1925 was 3,016 long tons; smelter production was 3,171 long tons.* (d) *Monthly average of first quarter, 1926.* (e) *Exports, not necessarily overseas.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
TIN—(*contd.*)								
United States :								
Imports of bar, block or pig tin	Long ton	6,401	4,574	7,449	76,646	7,031	6,501	6,699
Re-exports of bar, block or pig tin	do.	63	40	33	570	65	137	170
Exports of bar, block or pig tin	do.	35	72	23	362	49	11	23
Bolivia :								
Tin content of shipments to Europe and the United States	Long ton	1,493	4,285	1,952	30,240	2,028	2,586	2,560
China :								
Tin content of shipments (*a*) .	Long ton	250	302	889	7,421	247	74	
Dutch East Indies :								
Tin content of ore produced .	Long ton				32,749			
Shipments of Banca tin (*a*) .	do.	252	1,273	1,624	14,177	770	932	1,710
French Indo-China :								
Exports of tin-tungsten ore .	Long ton	61	40	46	465	29		
Exports of tin ingots . .	do.	46	10	49	321	23		
Siam :								
Tin content of ore produced .	Long ton				6,800			
ZINC								
BRITISH EMPIRE								
United Kingdom :								
Zinc content of ore produced .	Long ton	(*c*) 61	(*c*) 61	(*c*) 61	738			
Smelter output	do.				42,000			
Exports of spelter and wrought zinc, etc.	do.	413	341	420	5,393	350	390	302
Total imports of spelter . .	do.	10,481	13,628	13,028	135,780	12,753	13,255	15,730
Total imports of wrought zinc, etc.	do.	1,341	1,873	1,948	18,383	1,416	1,586	1,617
Re-exports of spelter . .	do.	75	178	1,179	7,686	1,172	242	5

Northern Rhodesia :								
Smelter output . . .	Long ton	14	10	14	148	—	—	—
Canada :								
Zinc content of ore produced .	Long ton				49,407			
Exports of ore . . .	do.	2,378	2,275	3,730	43,161	—	—	—
Smelter output . . .	do.	3,484	3,748	3,720	34,358	4,105	3,854	4,694
Exports of spelter . . .	do.	2,541	2,815	2,791	22,244	3,061	3,924	4,610
India :								
Production of concentrates in Burma	Long ton	1,808	1,809	1,826	16,600	(*b*) 3,983	(*b*) 3,983	(*b*) 3,983
Exports of spelter, etc., overseas	do.	13	4,009	10	20,967	3,030	2,950	6,261
Total imports of spelter, etc., from overseas . . .	do.	579	561	586	6,606	743	593	469
Australia :								
Zinc content of ore produced in (*d*) :								
Queensland. . . .	Long ton	—	—	—	171	—	—	—
Tasmania	do.	(*c*) 212	(*c*) 212	(*c*) 212	3,113	(*b*) 270	(*b*) 270	(*b*) 270
Exports overseas of ore, etc., from :								
Queensland (ore) . .	Long ton	—	38	—	462	—	—	—
South Australia (concentrates)	do.	14,005	16,128	32,734	181,844	12,482	21,039	17,967
Smelter output in :								
Tasmania	Long ton	(*c*) 3,656	(*c*) 3,656	(*c*) 3,656	42,976	(*b*) 3,583	(*b*) 3,583	(*b*) 3,583
Commonwealth . . .	do.	3,937	3,810	3,923	45,698	3,911	3,592	3,999
Exports of spelter overseas from :								
New South Wales . .	Long ton	1	1	801	2,864	2	999	—
Tasmania	do.	3,660	—	1,100	24,361	1,750	3,800	2,752
FOREIGN COUNTRIES								
Austria (Carinthia) :								
Production of ore . . .	Long ton	40	379	202	1,402	11	11	28

(*a*) *From 26th of previous month to 25th of month stated.* (*b*) *Monthly average of first quarter, 1926.* (*c*) *Monthly average of fourth quarter, 1925.* (*d*) *Zinc content of ore produced in the Commonwealth during 1925 was 138,783 long tons.*

Particulars.	Unit.	October 1925.	November 1925.	December 1925.	Year 1925.	January 1926.	February 1926.	March 1926.
ZINC—(*contd.*)								
Belgium :								
Smelter output	Long ton	14,690	14,926	15,605	169,127	13,254	14,572	16,018
Belgium-Luxemburg E.U. :								
Imports of ore	Long ton	62,999	26,306	88,103	503,948	32,073	34,249	26,790
Exports of ore	do.	1,645	1,322	2,539	21,749	1,179	3,398	1,720
Imports of spelter and scrap	do.	590	942	1,428	7,924	732	410	325
Exports of spelter and scrap	do.	7,541	6,070	8,228	81,057	6,032	7,662	9,499
Imports of sheets	do.	16	16	17	160	11	17	12
Exports of sheets	do.	4,325	4,325	4,543	47,973	3,171	3,498	4,726
Czechoslovakia :								
Imports of ore	Long ton					253	156	1,201
Exports of ore	do.					—	256	—
Imports of spelter and scrap	do.	1,978	1,615	1,790	16,069	664	1,111	1,192
France :								
Production of ore	Long ton	1,082	1,293	3,965	14,528	2,909	4,061	
Imports of ore	do.	15,577	7,612	11,937	167,718	1,819	7,057	24,184
Exports of ore	do.	1,405	1,466	4,128	23,034	1,403	1,344	1,673
Imports of spelter, sheets and scrap	do.	3,253	3,703	4,148	45,628	4,737	4,951	4,694
Exports of spelter, sheets and scrap	do.	1,692	1,302	1,079	19,412	806	1,160	869
Germany :								
Imports of ore	Long ton	8,043	3,287	9,076	90,903	5,457	11,282	10,556
Exports of ore	do.	6,101	8,198	6,859	72,443	4,939	6,631	7,526
Smelter output	do.	4,614	4,613	4,699	57,705	4,799	4,451	5,170
Imports of spelter, dust, sheets, wire and scrap	do.	8,397	10,805	5,400	133,560	4,387	4,663	5,180
Exports of spelter, dust, sheets, wire and scrap	do.	3,176	4,616	4,776	26,662	3,324	3,024	2,806

Italy :								
Production of ore	Long ton				161,197			
Exports of ore	do.	3,596	22,026	7,928	171,578	12,925	10,001	17,417
Smelter production . .	do.				6,277			
Imports of spelter, sheets, plates and scrap	do.	1,811	1,449	1,812	18,140	631	1,200	1,727
Netherlands :								
Imports of ore	Long ton	7,513	13,565	9,757	106,649	14,129	13,292	12,921
Imports of spelter and scrap .	do.	134	306	290	3,237	369	316	355
Exports of spelter and scrap .	do.	2,053	2,183	2,667	24,904	2,248	1,997	2,421
Imports of sheets, wire and dust	do.	956	670	429	7,244	508	483	665
Exports of sheets, wire and dust	do.	111	66	34	1,109	88	61	94
Upper Silesia :								
Production of ore	Long ton	29,675	30,688	24,623	313,576			-
Smelter output	do.	9,300	8,265	8,209	89,487	8,351	7,671	8,779
Algeria :								
Production of ore	Long ton	3,345	1,120	4,285	47,391	(a) 5,450	(a) 5,450	(a) 5,450
Tunis :								
Production of ore	Long ton	1,672	1,969	1,515	19,196			
Mexico :								
Zinc content of ore produced .	Long ton	5,072	4,291	14,381	45,034	3,870	5,997	6,485
Smelter output	do.	320	350	401	1,255	500	462	524
United States :								
Zinc content of ore produced .	Long ton				636,000			
Shipments of Joplin ore . .	do.	72,569	65,996	59,356	726,074	68,374	68,833	64,206
Total imports of ore . .	do.	3,455	184	1,545	12,086	189	3,147	1,453
Exports of ore and dross .	do.	14,933	14,018	6,384	75,874	8,582	7,539	9,674
Smelter output	do.	45,087	45,205	48,030	511,559	50,347	47,533	48,581
Exports of spelter, dust, sheets, etc.	do.	6,624	3,665	2,690	73,919	1,090	1,613	2,594
Bolivia :								
Exports of ore	Long ton	366	1,346	1,902	6,110	1,491		723
Zinc content of ore exported .	*do.*					*529*		*345*
French-Indo China :								
Exports of ore	Long ton	9,598	2,842	4,405	49,163	5,280		

(a) *Monthly average of first quarter, 1926.*

Printed by H.M.S.O. Press, Harrow.

PART A—PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial, and Indian Governments

---

TIMBERS FROM THE GOLD COAST—I

A COMPREHENSIVE collection of Gold Coast timbers was forwarded from the Colony for display at the British Empire Exhibition, and at the request of the Conservator of Forests the Imperial Institute undertook to carry out a systematic investigation of about thirty of the more promising woods.

The timbers are being submitted in turn to complete examination in the timber laboratory of the Imperial Institute in order to determine their mechanical properties and working qualities, and the opinion of the Advisory Committee on Timbers of the Institute is subsequently obtained as to the purposes for which they could be utilised and their commercial possibilities in the United Kingdom.

The investigation will necessarily occupy considerable time, and it is proposed to publish the results of the examination of the timbers as they are completed. The timbers now dealt with are mentioned below, together with notes on the trees and timber compiled from the Forestry Section of the *Gold Coast Manual* and from Chipp's *List of Trees, Shrubs, and Climbers of the Gold Coast, Ashanti, and the Northern Territories.*

1. *Subaha* (*Mitragyna macrophylla*, Hiern.).—Nat. Ord. Rubiaceæ. A medium-sized tree growing in fresh-water swamps. It is fairly common and has an average girth of 7 ft. The wood is used locally for furniture.

2. *Attabini or Niankuma* (*Tarrietia utilis*, Sprague).—Nat. Ord. Sterculiaceæ. Common throughout the south-west of the Colony and reported from two places in the east. The average girth is 8 ft. The wood is said to be used for making oars at Axim.

3. *Baku* (*Mimusops* sp.).—Nat. Ord. Sapotaceæ. Common in the west of the Colony and Ashanti. One of the largest timber trees of the Gold Coast, the average girth being 10 ft. The wood is employed locally for making furniture.

4. *Kaku or Ironwood* (*Lophira procera*, A. Chev.).—Nat. Ord. Ochnaceæ. Grows in the moistest parts of the Evergreen Forest. It has an average girth of 8 ft. The timber is much valued for fuel and is used in the mines for underground construction work.

5. *Odum* (*Chlorophora excelsa*, Benth. and Hook.).—Nat. Ord. Urticaceæ. One of the largest and most valuable timber trees of the Gold Coast, and distributed throughout the Colony and Ashanti. It has an average girth of 11 ft. The wood is recommended for work under water and is said to be immune from the attacks of white ants. It is used extensively in the Gold Coast for building, sleepers and furniture.

6. *Penkwa or African Cedar* (*Entandrophragma* sp.).—Nat. Ord. Meliaceæ. Species of Entandrophragma are distributed throughout the western part of the Colony and Ashanti, but are not very common. The trees reach a large size, the average girth being 10 ft. The wood is used locally for building and for furniture.

7. *Konkruma*.—The botanical identity of this tree, which is fairly common in the Gold Coast, is uncertain. According to the *Gold Coast Manual* it is believed to be *Morinda citrifolia*, Linn. (Nat. Ord. Rubiaceæ). The tree has an average girth of 7 ft. and the wood is used by the natives for building.

The results of the tests on the different woods are dealt with in the following pages. Before proceeding to these, however, it is considered desirable to give an outline of the methods employed at the Imperial Institute for standard mechanical tests on clear, straight-grained specimens. These methods conform to those adopted

by the Forestry Departments in Canada, India and the United States, as well as by the Forest Products Research Laboratory of the Department of Scientific and Industrial Research in this country. The results obtained by the different workers are therefore strictly comparable with one another.

Methods Employed for the Standard Mechanical Tests on Clear, Straight-grained Specimens

Static Bending.—A beam, 2 × 2 × 30 in., is supported over a 28 in. span. The load is applied at the centre and at a constant rate of deflection of 0·105 in. per minute until the beam fails. Readings of load and deflection are taken simultaneously and a curve plotted, from which the values given in the summary of results are derived.

Compression Parallel to Grain.—A block, 2 × 2 × 8 in., is compressed in the direction of its length. Deformation is measured between two collars attached to the specimen 6 in. apart, the speed of descent of the loading head being 0·024 in. per minute. Readings of load and deformation are taken simultaneously and a curve plotted, from which the values given in the summary of results are derived.

Compression Perpendicular to Grain.—A block, 2 × 2 × 6 in., is laid upon its side and pressure applied to a radial surface through a plate 2 in. wide laid across the centre of the block and at right angles to its length. The loading head descends 0·024 in. per minute. Readings of load and indentation are taken simultaneously and a curve plotted from which a value for fibre stress at elastic limit is derived.

Hardness.—Hardness is measured by determining the load required to imbed a steel sphere (of 0·444 in. diameter) to one-half its diameter in the wood. The speed of descent of the loading head is 0·25 in. per minute. This test is applied to radial, tangential and end surfaces on a block 2 × 2 × 6 in.

Shearing Parallel to Grain (see figure No. 1).—The shearing strength is determined for radial and tangential planes of failure. The test is made by applying force to a 2 × 2 in. lip, made by cutting out a piece ½ × ½ in. from a block, 2 × 2 in. in section and 2½ in. long. The

speed of descent of the loading head is 0·015 in. per minute. The maximum load is observed and the maximum shearing strength calculated.

Cleavage (see figure No. 2).—The splitting strength is determined for radial and tangential planes of failure. A block, 2 × 2 in. in section and 3¾ in. long, is cut across at one end by a circular groove 1 in. in diameter (centre ½ in. from end of specimen), leaving a net splitting length of 3 in. The block is held in two special grips which are drawn apart at a constant speed of 0·25 in. per minute. The load at failure is observed and the splitting strength per inch width of specimen calculated.

Tension Perpendicular to Grain (see figure No. 3).—The tensile strength is determined for radial and tangential planes of failure. A block, 2 × 2 in. in section and 2½ in. long, cut across both ends by circular grooves 1 in. in diameter (centres ½ in. from ends of specimen), leaving a net breaking area of 2 × 1 in., is held in two special grips which are drawn apart at a constant speed of 0·25 in. per minute. The breaking load is observed and the tensile strength perpendicular to the grain calculated.

Specific Gravity.—The specific gravity of the mechanical test pieces is determined, the results being expressed in terms of the weight of the wood when oven-dry and the volume at the time the mechanical tests are made.

Moisture Content.—This figure is based on the weight of the wood when oven-dry.

Weight per Cubic Foot.—This figure is based on the weight and volume of the wood at the time the mechanical tests are made.

1. SUBAHA (*MITRAGYNA MACROPHYLLA*)

The specimens of Subaha wood received at the Institute consisted of two planks, 12 ft. long, 2 ft. wide, and 2 and 3 in. thick respectively. The centres of the planks were cracked, and one side of the log from which they were cut had been badly attacked by large wood borers; in addition the outer wood showed a number of "pinhole" borings.

The wood was light brownish-yellow, free from knots, and did not warp or "check." It had a slightly alter-

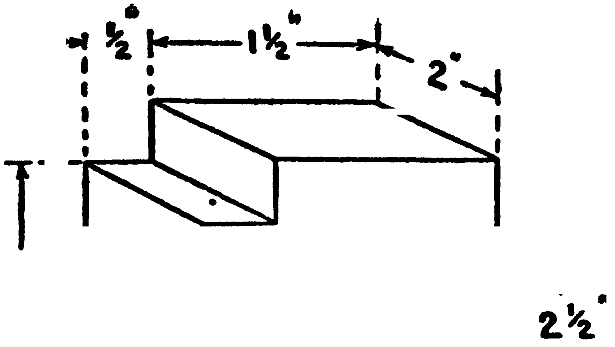

Figure No. 1.

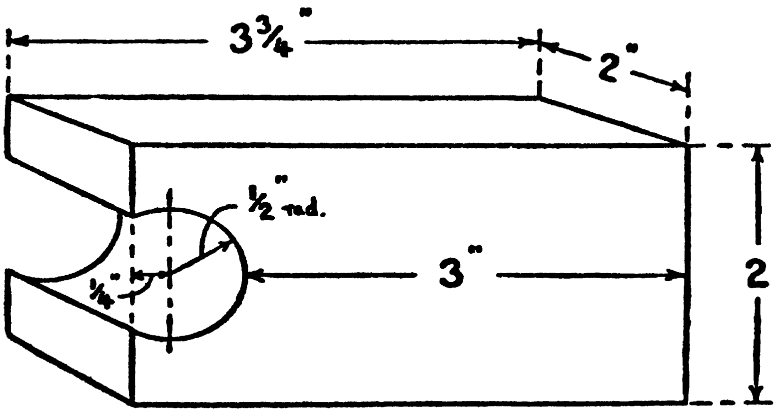

Figure No 2.

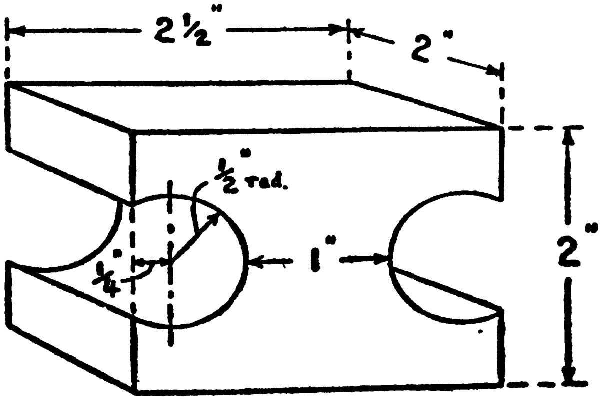

Figure No. 3.

nating spiral grain, fairly fine and close. There was no distinction between the sapwood and heartwood.

In *transverse section*, very numerous, minute pores were just visible to the eye, whilst the rays were seen with a lens as fine, reddish-brown lines, densely distributed. The rings, which averaged ten to the inch, were indicated by their boundaries, seen as fine lines free from pores and slightly darker than the surrounding wood.

In *radial section*, the pores appeared as long, fine grooves, with very slight resinous contents; the rays were seen as narrow, slightly lustrous, reddish flakes. The rings were vaguely indicated by the boundaries, which appeared as narrow lines of a slightly lighter tint than the surrounding wood.

In *tangential section*, the pores appeared as in the radial section. The rays were visible as fine, short, reddish lines tapering at the ends, whilst the rings were shown by narrow undulating bands of lighter colour, usually poreless.

Results of Mechanical Tests on Air-dry Timber

		Maximum.	Minimum.	Mean.
Static bending:				
Maximum calculated longitudinal shear	*lb./sq. in.*	405	312	365
Fibre stress at elastic limit	"	8,540	7,280	7,750
Modulus of rupture	"	11,520	8,690	10,250
Modulus of elasticity	"	1,763,000	1,387,000	1,517,000
Work in bending to elastic limit	*inch-lb./cu. in.*	2·17	1·85	2·06
Work in bending to maximum load	"	11·14	5·01	8·79
Compression parallel to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	5,460	4,230	4,850
Maximum crushing strength	"	6,230	4,860	5,580
Modulus of elasticity	"	1,474,000	1,081,000	1,308,000
Compression perpendicular to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	1,094	808	892
Shearing parallel to grain:				
Shearing strength:				
Surface of failure — Radial	*lb./sq. in.*	1,305	799	1,020
Surface of failure — Tangential	"	1,750	1,235	1,500
Cleavage:				
Splitting strength:				
Surface of failure — Radial	*lb. per inch width*	350	312	331
Surface of failure — Tangential	"	502	418	458

		Maximum.	Minimum.	Mean.
Tension perpendicular to grain :				
Tensile strength :				
Surface of failure { Radial	*lb./sq. in.*	663	492	577
Surface of failure { Tangential	,,	1,316	1,025	1,155
Hardness :				
Load required to imbed a 0·444 inch steel sphere to one-half its diameter :				
Radial surface	*lb.*	1,070	740	860
Tangential surface	,,	970	670	830
End surface	,,	1,310	1,090	1,220
Specific gravity		0·533	0·450	0·503
Moisture	*per cent.*	18·8	9·1	12·1
Weight per cubic foot . . .	*lb.*	38·1	31·5	35·7

Results of Working Tests

(1) *Sawing.*—The wood cuts easily with machine and hand saws.

(2) *Planing.*—The wood planes readily and a smooth surface is obtainable, but a fine cut is necessary on radial-cut wood, as there is a tendency to " pick up " owing to the alternating spiral grain.

(3) *Boring.*—Machine and hand boring tools give good, clean holes.

(4) *Nailing and Screwing.*—Nails and screws can be driven in readily without splitting the wood, and hold firmly.

(5) *Working with Gouge and Chisel.*—The wood cuts easily and cleanly.

(6) *Mortising and Dovetailing.*—The wood cuts well in the mortising machine, but the joints obtainable are not strong as the wood is fairly soft.

(7) *Turning.*—The wood turns readily, giving a fair finish with tools and a smooth surface with glass-paper.

(8) *Glueing.*—Glue adheres firmly to the wood : joints fail through the wood cleaving.

(9) *Staining.*—The wood takes stains readily and uniformly.

(10) *Polishing.*—The wood absorbs the polish readily, and a number of applications are necessary to obtain good results.

(11) *Varnishing.*—Satisfactory.

Remarks

Subaha is a soft, fairly light wood of plain appearance, which works easily with all machine and hand tools.

The wood has fair strength in transverse bending and in compression along the grain, and is of average stiffness. The resistance to compression across the grain is fairly low owing to the porous nature of the wood, and the hardness, shearing strength and tensile strength are moderate.

The Imperial Institute Advisory Committee on Timbers reported that if it regularly suffers from the "pin-hole" insect borings present in the sample examined, it would be of no value for export. Clean, sound timber might possibly be useful as a second-grade substitute for mahogany, but it is doubtful if it would compete successfully with the many timbers of this class already available, as it lacks character and does not readily finish to a fine surface. Subaha wood should, however, be useful in the Gold Coast for many light constructional and other purposes where great strength is not required, and for which imported softwoods are largely used at present.

2. Attabini or Niankuma (*Tarrietia utilis*)

The specimens consisted of two planks, 10½ ft. long, 2½ ft. wide, and 2 and 3 in. thick respectively. The wood was in good condition, the planks being only slightly cracked up the middle, and was free from knots.

The heartwood was reddish-brown, darkening with exposure; the sapwood, which was about 1 in. thick, was slightly lighter with some greyish discolorations. The surface was slightly lustrous and a little greasy to the touch. The grain was moderately alternating spiral, fairly coarse and open.

In *transverse section* the wood was reddish-brown, with fairly numerous, medium-sized pores, occasionally completely filled with resin. The rays, which were numerous, appeared as narrow red lines, 0·1 mm. wide, inconspicuous to the naked eye on account of the lack of contrast in colour with the ground tissue. The rings, which averaged nine to the inch, were indicated by a zone of light-coloured quick-growth wood, followed by a narrow band of darker,

slow-growth wood and then by a dark, fine line as boundary; the later quick-growth wood having most pores.

In *radial section* the wood was light reddish-brown and slightly lustrous, the alternating spiral grain being indicated by the variation in shading and the manner in which the pores were cut through. The pores were visible as long, reddish grooves, occasionally completely filled but usually with only slight contents; the rays were visible as medium-sized reddish flakes. The rings were shown by the boundaries, which appeared as fine, reddish lines.

In *tangential section* the wood was pinkish-brown or salmon-coloured, and slightly lustrous. The pores appeared as very long, reddish grooves, which were occasionally absent in the early quick-growth wood. The rays were visible as very numerous, fine, short, reddish lines, tapering at the ends; the rings were indicated by the contrast in colour of the quick and slow-growth wood, with a wavy darker line as boundary to the ring.

Results of Mechanical Tests on Air-dry Timber

		Maximum.	Minimum.	Mean.
Static bending :				
Maximum calculated longitudinal shear	*lb./sq. in.*	420	323	381
Fibre stress at elastic limit	,,	8,460	7,290	7,860
Modulus of rupture	,,	11,800	9,130	10,780
Modulus of elasticity	,,	1,497,000	1,201,000	1,327,000
Work in bending to elastic limit	*inch-lb./cu. in.*	2·98	1·90	2·44
Work in bending to maximum load	,,	11·20	4·67	8·09
Compression parallel to grain :				
Fibre stress at elastic limit	*lb./sq. in.*	5,730	4,520	5,000
Maximum crushing strength	,,	6,130	5,030	5,520
Modulus of elasticity	,,	1,605,000	1,009,000	1,287,000
Compression perpendicular to grain :				
Fibre stress at elastic limit	*lb./sq. in.*	1,192	884	1,051
Shearing parallel to grain :				
Shearing strength :				
Surface of failure — Radial	*lb./sq. in.*	1,327	1,178	1,252
Surface of failure — Tangential	,,	1,360	1,023	1,259
Cleavage :				
Splitting strength :				
Surface of failure — Radial	*lb. per inch width*	450	338	390
Surface of failure — Tangential	,, ,,	459	379	413

			Maximum.	Minimum.	Mean.
Tension perpendicular to grain :					
Tensile strength :					
Surface of failure	Radial	*lb./sq. in.*	882	783	820
	Tangential	"	1,073	755	[illegible]
Hardness :					
Load required to imbed a 0·444 inch steel sphere to one-half its diameter :					
Radial surface . . .		*lb.*	970	580	[illegible]
Tangential surface . .		"	1,250	710	[illegible]
End surface . . .		"	990	590	[illegible]
Specific gravity			0·588	0·441	[illegible]
Moisture		*per cent.*	15·5	10·0	12·0
Weight per cubic foot . . .		*lb.*	40·9	30·7	34·9

Results of Working Tests

(1) *Sawing.*—The wood cuts easily with machine and hand saws.

(2) *Planing.*—The wood can be planed with ease, giving a smooth surface ; there is a very slight tendency to " pick up " on a radial surface.

(3) *Boring.*—Clean holes can be obtained readily with all boring tools.

(4) *Nailing and Screwing.*—Nails and screws can be driven in easily and are held firmly ; there is no tendency to split.

(5) *Working with Gouge and Chisel.*—The wood can be cut very readily, but it tears up when cut against the grain.

(6) *Mortising and Dovetailing.*—The wood cuts easily in the mortising machine. Fairly strong joints are obtainable, which fail by the wood crushing rather than splitting.

(7) *Turning.*—The wood turns rapidly and cleanly in the lathe ; a good surface is possible with sand-paper.

(8) *Glueing.*—Fairly strong joints can be obtained, as the glue adheres firmly to the wood.

(9) *Staining.*—The wood takes stains satisfactorily.

(10) *Polishing.*—The pores require filling before good results can be obtained.

(11) *Varnishing.*—Satisfactory when the pores are filled.

Remarks

Attabini is a soft, fairly light wood of good but rather coarse appearance. It works easily with most machine

and hand tools and finishes fairly well. It has little tendency to crack, and does not " check " when dried.

The transverse bending strength and resistance to compression long the grain are moderately good, though the wood is not stiff. The strength to resist shearing, cleavage, and tension and compression perpendicular to the grain is that of an average soft wood.

The Advisory Committee on Timbers reported that it was apparently identical with the timber which has been shipped to the United Kingdom and the United States from the Ivory Coast under the export name of " Nyankon," and sold in both countries as an " African mahogany." There also appeared to be little doubt that it has been included among the timbers hitherto shipped to the United Kingdom from the Gold Coast as " mahogany." When well selected it has been found to be an excellent timber with good working qualities. It has an attractive figure, but the timber must be cut on the quarter if this feature is to appear to advantage.

The Committee were of opinion that if supplies of Attabini are available from the Gold Coast at prices equal to average values of African mahogany, there should be a market for the timber in the United Kingdom, where it would be suitable for most purposes for which the more open-grained varieties of African mahoganies are employed.

3. Baku (*Mimusops* sp.)

The specimens received consisted of two planks, 13½ ft. long, 26 in. wide, and 2 and 3 in. thick respectively. The wood was light reddish-brown (darkening on exposure), with a slightly lustrous surface ; it was in sound condition, except for slight cracks and knots near the centre of the tree. The grain was alternating spiral, moderately fine and close.

In *transverse section* the wood was reddish-brown, with numerous small pores, sometimes joined by festoons of lighter-coloured soft tissue and occasionally filled with a red resinous substance. The rays were just visible to the eye as numerous, narrow, parallel, dull pinkish-brown lines ; whilst the rings, of irregular width and from 6 to

11 to the inch, were indicated by their bounda h were unbroken, concentric, dull pinkish-brown lines of relatively soft tissue. The pith was pinkish-brown, soft, of irregular shape, and approximately ⅜ in. in diameter.

In *radial section* the wood was pinkish-brown w h a slightly lustrous surface. The pores were visible as long, narrow, reddish grooves, usually with slight resinous contents and occasionally completely filled. The alternating spiral grain was indicated by the variation in the axial angle of the pores to the plane of cutting. The rays appeared as long, narrow, dull pinkish-brown flakes whilst the rings were shown by their boundaries, which formed narrow, pinkish-brown lines.

In *tangential section* the wood was similar in colour to the radial section and the pores were seen as long, narrow, reddish grooves. The very numerous rays were just visible to the eye as short, tapering, dull pinkish-brown lines; the rings were indicated by narrow, undulating pinkish-brown bands.

Results of Mechanical Tests on Air-dry Timber

		Maximum.	Minimum.	Mean.
Static bending:				
Maximum calculated longitudinal shear	*lb./sq. in.*	553	384	446
Fibre stress at elastic limit	,,	9,550	7,490	8,520
Modulus of rupture	,,	15,220	10,700	12,400
Modulus of elasticity	,,	1,777,000	1,010,000	1,404,000
Work in bending to elastic limit	*inch-lb./cu. in.*	3·52	2·22	2·72
Work in bending to maximum load	,, ,,	16·65	4·82	9·63
Compression parallel to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	5,950	4,140	4,890
Maximum crushing strength	,,	6,550	5,040	5,930
Modulus of elasticity	,,	1,965,000	989,000	1,434,000
Compression perpendicular to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	1,990	1,500	1,680
Shearing parallel to grain:				
Shearing strength:				
Surface of failure { Radial	*lb./sq. in.*	1,885	1,560	1,713
Surface of failure { Tangential	,,	1,760	1,305	1,542
Cleavage:				
Splitting strength:				
Surface of failure { Radial	*lb. per inch width*	560	448	506
Surface of failure { Tangential	,, ,,	592	418	495

		Maximum.	Minimum.	Mean.
Tension perpendicular to grain :				
Tensile strength :				
Surface of failure { Radial	*lb./sq. in.*	1,245	915	1,047
Tangential	,,	1,159	856	1,020
Hardness :				
Load req ed to imbed a 0·444 inch steel here to one-half its diameter :				
Radial surface . . .	*lb.*	1,520	1,040	1,305
Tangential surface . .	,,	1,580	1,180	1,398
End surface . . .	,,	1,790	1,280	1,524
Specific gravity		0·666	0·547	0·623
Moisture	*per cent.*	15·4	9·3	12·8
Weight per cubic foot . . .	*lb.*	46·7	39·0	44·0

Results of Working Tests

(1) *Sawing.*—The wood cuts readily with hand and machine saws.

(2) *Planing.*—A good smooth surface is obtainable, but there is a slight tendency to " pick up " on a radial surface.

(3) *Boring.*—The wood works well with all boring tools and has little tendency to split.

(4) *Nailing and Screwing.*—Nails and screws can be driven into the wood fairly easily; it holds them firmly and does not split.

(5) *Working with Gouge and Chisel.*—The wood cuts easily with the grain, but tears up when cut against the grain.

(6) *Mortising and Dovetailing.*—It works readily and cleanly in a mortising machine, and joints have moderate strength.

(7) *Turning.*—The wood cuts fairly cleanly and rapidly in the lathe; a good smooth finish is obtainable with glass-paper.

(8) *Glueing.*—Glued joints have moderate strength.

(9) *Staining.*—The wood takes stains satisfactorily.

(10) *Varnishing and Polishing* give good results.

Remarks

Baku is a rather hard, moderately heavy wood of good appearance similar to that of mahogany. It works fairly easily with most hand and machine tools and finishes well.

It has good strength in transverse bending and in compression parallel to the grain and is moderately stiff.

Its resistance to shearing, cleavage, and compression and tension perpendicular to the grain is also satisfactory.

The following report on the possible uses and value of the timber was furnished by the Advisory Committee on Timbers.

From time to time this timber has been sold in the United Kingdom as a second grade "African mahogany." It is much superior in appearance and working qualities to other better-known mahogany substitutes (e.g., luan from the Philippines and Borneo cedar) which find a ready market in this country.

Baku has good working qualities and should be useful locally for a great variety of purposes including furniture, joinery and general construction work. In the United Kingdom the timber would find a ready use for interior work in furniture and cabinet making, such as framing, and sides and bottoms of drawers; it is probably too plain in appearance for the better class of exterior work in such manufactures. Baku would also be well suited for motor-body construction on account of its strength, working qualities and moderate weight.

If the regular marketing of the timber in the United Kingdom as a furniture and cabinet wood is contemplated, success will depend upon whether it can be offered at a price below that of medium grades of African mahogany. At the present time Baku would probably command two-thirds of the price of African mahogany, which was quoted at 3*d.* to 3½*d.* per ft. (4*d.* per ft. for good logs), brokers' measure (January–February 1926). If offered for motor-body work, Baku would need to compete in price with American ash, the recent values of which were as follows: round logs 3*s.* to 3*s.* 6*d.* per cubic ft.; planks and boards 3*s.* 6*d.* to 7*s.* 6*d.* per cubic ft. (January 31st, 1926).

The timber would be best marketed as square-edge planks, but since the facilities for such conversion are probably not yet available in the Gold Coast, it could be exported as squared logs.

4. Kaku or "Ironwood" (*Lophira procera*)

The specimens received consisted of two planks, 10 ft. long, 33 in. wide and 3 in. thick. Except for rather bad

cracks near the centre of the planks, the wood was sound and in good condition.

The heartwood was reddish-brown, darkening with exposure; the sapwood, which was about 4 in. wide, was lighter-coloured and had light yellowish stains at the outer edges. The grain was alternating spiral, fairly coarse and open.

In *transverse section* the wood was dark reddish-brown with a lighter-coloured sapwood. The pores were moderately numerous, of fair size and distinct; many of them were filled with a light pinkish-brown substance, a few had dark red resinous contents, whilst others were empty. The rays were visible with a lens as very numerous, fine, light lines, whilst the rings were indefinite. Very numerous, fine, close, undulating, concentric, continuous lines of pinkish-brown soft tissue were clearly visible against the dark reddish-brown ground tissue.

In *radial section* the wood was a lighter reddish-brown and slightly lustrous. The pores were visible as coarse grooves; they usually had pinkish-brown contents, but were occasionally empty or partially filled with a red resinous substance. The rays were indistinct, narrow, dull pinkish-brown flakes and the soft tissue appeared as fine, closely-spaced, parallel, dull lines of similar colour to the rays.

In *tangential section* the wood was darker than in the radial section. The pores were very conspicuous as long coarse grooves. The rays were vaguely distinguished with the aid of a lens as narrow, short lines tapering at the ends, and having the same colour as the ground tissue. The soft tissue was visible as wavy, dull pinkish-brown bands, giving a highly ornamental appearance to the wood.

Results of Mechanical Tests on Air-dry Timber

Static bending:		Maximum.	Minimum.	Mean.
Maximum calculated longitudinal shear	*lb./sq. in.*	896	693	810
Fibre stress at elastic limit	,,	15,420	11,960	13,850
Modulus of rupture	,,	25,460	19,400	22,870
Modulus of elasticity	,,	3,000,000	2,240,000	2,732,000
Work in bending to elastic limit	*inch-lb./cu. in.*	4·12	2·82	3·56
Work in bending to maximum load	,, ,,	44·6	16·5	33·5

		Maximum.	Minimum.	Mean.
Compression parallel to grain :				
Fibre stress at elastic limit	*lb./sq. in.*	10,260	[illegible]	[illegible],470
Maximum crushing strength	„	11,610	[illegible]	[illegible],450
Modulus of elasticity .	„	3,388,000	1,674[illegible]	[illegible],000
Compression perpendicular to grain :				
Fibre stress at elastic limit	*lb./sq. in.*	2,870	2,140	2,420
Shearing parallel to grain :				
Shearing strength :				
Surface of failure { Radial	*lb./sq. in.*	2,650	1,680	[illegible]
Surface of failure { Tangential	„	2,790	2,460	2,652
Cleavage :				
Splitting strength :				
Surface of failure { Radial	*lb. per inch width*	682	389	483
Surface of failure { Tangential	„ „	869	603	727
Tension perpendicular to grain :				
Tensile strength :				
Surface of failure { Radial	*lb./sq. in.*	1,452	813	1,226
Surface of failure { Tangential	„	2,315	1,140	1,884
Hardness :				
Load required to imbed a 0·444 inch steel sphere to one-half its diameter :				
Radial surface . . .	*lb.*	4,140	3,430	3,810
Tangential surface . .	„	3,980	3,580	3,810
End surface	„	4,650	4,010	4,310
Specific gravity		0·968	0·872	0·930
Moisture	*per cent.*	20·8	12·2	17·3
Weight per cubic foot . . .	*lb.*	70·5	65·6	68·5

Results of Working Tests

(1) *Sawing.*—The wood is moderately hard to cut with hand and machine saws.

(2) *Planing.*—It is difficult to plane except on a tangential surface, where a good result can be obtained fairly readily. It "picks up" badly on a radial surface and is almost impossible to plane perpendicularly to the grain.

(3) *Boring.*—Gimlets are difficult to use and the wood splits; bradawls make very little impression and the wood is too hard for centre bits. Machine-driven boring tools cut fairly cleanly and readily, but the drills heat up considerably.

(4) *Nailing and Screwing.*—The wood is too hard for nails; screws are very difficult to drive in and usually break unless large holes are bored for them.

(5) *Working with Gouge and Chisel.*—The wood is fairly hard to cut, but good results are obtainable.

(6) *Mortising and Dovetailing.*—The wood cuts cleanly but with great difficulty in a mortising machine. The joints are strong and only fail by the wood splitting.

(7) *Turning.*—The wood cuts fairly readily and cleanly in the lathe. A good finish is obtainable with glass-paper.

(8) *Glueing.*—The glue adheres well.

(9) *Staining.*—The wood does not absorb the stain readily, but moderately good results are obtainable.

(10) *Polishing and Varnishing.*—The pores need filling, but the wood finishes well.

Remarks

Kaku is a very heavy, very hard wood of coarse but ornamental appearance. It works with extreme difficulty with most hand tools, but more readily with machine tools ; a fairly good finish can be obtained with care.

Its resistance to transverse bending and compression parallel to the grain is very great, and it is very stiff and has a high shock-resisting ability. Its shearing strength parallel to the grain and its compression and tensile strengths perpendicular to the grain are very good, but its resistance to cleavage is comparatively low.

The Advisory Committee on Timbers furnished the following report on the possible uses and value of the timber.

Consignments of this timber from Nigeria have appeared on the market from time to time under the names of West African Ironwood, Red Ironwood, African oak and Ekki.

On account of its great strength, hardness and evident durability, Kaku would probably prove a valuable timber in West Africa for heavy construction work, including piling, wharf construction and bridge building. It should also be useful for mining timbers and as railway sleepers.

As regards export, it is unlikely that Kaku would find any commercial outlet in this country. It might possibly sell as a substitute for jarrah for heavy construction work, but it would not serve in place of jarrah for other purposes for which that timber is used.

Nigerian Ekki has been claimed to be specially suitable for switch-boards on account of its high electrical resistance. The timber is too heavy, hard and difficult to work for use in furniture manufacture and does not possess an appearance which might compensate for its physical disadvantages. The timber also constantly exhibits surface checks which would effectively preclude its use for any ornamental purposes. These checks might possibly be avoided by careful seasoning, but it is doubtful if the trouble involved would be worth while.

5. Odum (*Chlorophora excelsa*)

The specimens received consisted of two planks, 10 ft. long, 34 in. wide and 3 and 2 in. thick respectively. The wood was in sound condition except for a large ring shake in each plank and some cracks near the centre surrounded by brownish discolorations.

The heartwood was light greenish-brown, darkening with exposure; the sapwood, which was light pinkish-yellow, was about 3 in. wide and had a greyish stain approximately ½ in. wide at the outer layers. The grain was coarse, open and alternating spiral.

In *transverse section* the wood was greenish-brown with fairly plentiful and moderately large pores, usually having brownish resinous contents; the pores were joined by lines of pinkish-yellow, soft tissue, forming undulating festoons. The rays were just visible to the eye as numerous, fine, light pinkish-yellow parallel lines. The rings, which averaged eight to the inch, were indicated by their boundaries, which formed fine, continuous lines of soft tissue bordering narrow zones of slightly darker and denser wood.

In *radial section* the wood was yellowish-brown and lustrous. The pores were fairly coarse grooves usually having soft, brown, resinous contents. The rays were visible as very numerous, dull pinkish-yellow flakes. The rings were vaguely shown by narrow, darker-shaded bands of denser wood near the boundary lines of soft tissue, which appeared as numerous, dull pinkish-yellow, continuous parallel lines.

In *tangential section* the wood was yellowish-brown,

with a lu‿rous and satiny surface. The pores were seen as long, ‿‿arse, brownish grooves. The rays were visible with a lens as very numerous, short, fine, light yellowish lines tapering at the ends; the rings were vaguely indicated by undulating narrow bands slightly darker than the surrounding wood and bordered by wavy, dull pinkish-yellow, narrow bands of soft tissue.

Results of Mechanical Tests on Air-dry Timber

		Maximum.	Minimum.	Mean.
Static bending:				
Maximum calculated longitudinal shear	*lb/sq. in.*	601	493	535
Fibre stress at elastic limit	,,	11,470	8,810	10,070
Modulus of rupture	,,	17,030	13,800	14,990
Modulus of elasticity	,,	1,934,000	1,473,000	1,744,000
Work in bending to elastic limit	*inch-lb./cu. in.*	4·09	2·18	3·07
Work in bending to maximum load	,, ,,	14·11	8·75	11·0
Compression parallel to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	7,740	7,280	7,500
Maximum crushing strength	,,	8,590	7,600	8,180
Modulus of elasticity	,,	2,140,000	1,323,000	1,712,000
Compression perpendicular to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	1,688	1,345	1,483
Shearing parallel to grain:				
Shearing strength:				
Surface of failure: Radial	*lb./sq. in.*	1,520	1,270	1,390
Surface of failure: Tangential	,,	1,330	1,060	1,190
Cleavage:				
Splitting strength:				
Surface of failure: Radial	*lb. per inch width*	356	275	313
Surface of failure: Tangential	,, ,,	438	327	387
Tension perpendicular to grain:				
Tensile strength:				
Surface of failure: Radial	*lb./sq. in.*	900	665	762
Surface of failure: Tangential	,,	1,046	838	925
Hardness:				
Load required to imbed a 0·444 inch steel sphere to one-half its diameter:				
Radial surface	*lb.*	1,330	980	1,120
Tangential surface	,,	1,420	1,030	1,200
End surface	,,	1,550	1,320	1,410
Specific gravity		0·566	0·514	0·545
Moisture	*per cent.*	16·2	11·0	13·5
Weight per cubic foot	*lb.*	40·0	36·2	38·5

Results of Working Tests

(1) *Sawing.*—The wood cuts easily with machine and hand saws.

(2) *Planing.*—The wood " picks up " on a radial surface, but otherwise it planes easily and finishes smoothly.

(3) *Boring.*—All boring tools give good results, but there is a slight tendency to split with gimlet and bradawl.

(4) *Nailing and Screwing.*—Nails and screws can be driven in easily and are held firmly, but there is a slight tendency to split.

(5) *Working with Gouge and Chisel.*—The wood can be cut easily, but tends to tear up.

(6) *Mortising and Dovetailing.*—The wood cuts readily and cleanly in mortising machine. Joints of moderate strength are obtainable.

(7) *Turning.*—The wood cuts easily in the lathe, but the fibres tear out slightly; a good smooth surface is obtainable with sand-paper.

(8) *Glueing.*—Fairly strong joints can be obtained as the glue adheres firmly.

(9) *Staining.*—The wood takes stain readily and gives satisfactory results.

(10) *Polishing and Varnishing.*—The wood requires filling, but finishes well.

Remarks

Odum is a firm wood of moderate weight and of good but rather coarse appearance. It works easily with most hand and machine tools and finishes fairly well, except for its tendency to " pick up " on radial sawn wood. It is fairly stiff and has a moderately high crushing and bending strength; its resistance to tension and compression perpendicular to the grain and to shear is moderate.

This sample of Odum is stiffer and stronger in static bending and in compression parallel to the grain than the two specimens of *Chlorophora excelsa* (Iroko) wood from Nigeria which were previously examined (see this BULLETIN, 1923, **21**, 458). Its weight and resistance to compression perpendicular to the grain and to shear are slightly greater than those of one of the specimens from Nigeria, but are considerably lower than those of the other specimen, which was a good typical sample of the species.

The Advisory Committee on Timbers furnished the following report on the possible uses and value of the timber.

Nigerian supplies of *Chlorophora excelsa*, marketed under the name of "African teak" or "Iroko," have been well known in the United Kingdom for many years, but there has been comparatively little sale for this excellent wood on account of its relatively high price. The Gold Coast sample appeared to come within the range of variation met with in the Nigerian timber.

Practical trials arranged by the Committee with Nigerian Iroko have shown that it gives very satisfactory results with artificial seasoning, and is well adapted for doors, window-frames and sashes. It would also be suitable for other classes of joinery such as sills, treads and staircases, and office and laboratory fittings. Experiments conducted under the auspices of the Committee have also shown that the timber would be well suited for motor-body construction if free from the deposits of mineral matter which occasionally occur in it.

The Committee are of opinion that Odum would readily find a market as a furniture wood in this country if sold at a price to compete with West African mahoganies. At present the timber is priced at about 4*s.* 6*d.* to 5*s.* per cubic ft. (calliper measure), which is too high to admit of ready sales. The timber is greatly valued in the Gold Coast and in Nigeria for furniture making, joinery and construction work of many kinds, and the Committee consider it unnecessary to offer suggestions as to local uses.

6. Penkwa, African Cedar (*Entandrophragma* sp.)

The specimens received consisted of two planks, 12 ft. long, 33 in. wide and 3 and 4 in. thick. The surface of the 4 in. plank had been slightly attacked by fungus, but otherwise, with the exception of several severe cracks, the material was in sound condition.

The heartwood was pinkish-brown and the sapwood slightly lighter, but there was no definite boundary. The grain was gently alternating spiral, wavy, fairly coarse and moderately open.

In *transverse section* the wood was light reddish-brown. The pores were very numerous and moderately small; they were arranged in radial groups of two, three or more, and were usually partially filled with a reddish substance. The rays were visible with a lens as very fine, numerous, parallel, light pinkish lines, whilst the soft tissue appeared as numerous, continuous, concentric, fine, light pinkish lines. The rings were indicated by a narrow boundary of darker colour.

In *radial section* the wood was pinkish-brown, slightly lustrous, and showed the curly grain. The pores were seen as numerous, long, narrow, inconspicuous grooves, generally partially filled with a reddish substance, whilst the rays were visible as very narrow, parallel, dull pinkish bands. The soft tissue appeared as numerous, parallel, fine, dull pinkish-brown lines darker than the ground tissue, and the rings were indicated by narrow, darker-shaded boundary lines.

In *tangential section* the wood was light reddish-brown with the pores appearing as inconspicuous, narrow, reddish grooves. The rays were seen through a lens as short, fine, light reddish lines tapering at the ends. The soft tissue was conspicuous in wavy, narrow, reddish bands. The rings were vaguely indicated by the distribution of the bands of soft tissue.

Results of Mechanical Tests on Air-dry Timber

		Maximum.	Minimum.	Mean.
Static bending:				
Maximum calculated longitudinal shear	*lb./sq. in.*	509	360	438
Fibre stress at elastic limit	"	10,920	7,120	8,830
Modulus of rupture	"	14,400	10,090	12,300
Modulus of elasticity	"	1,856,000	1,305,000	1,620,000
Work in bending to elastic limit	*inch-lb./cu. in.*	4·25	1·75	2·58
Work in bending to maximum load	" "	15·40	5·88	9·06
Compression parallel to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	5,100	3,610	4,250
Maximum crushing strength	"	6,830	5,340	5,900
Modulus of elasticity	"	2,192,000	1,665,000	1,846,000
Compression perpendicular to grain:				
Fibre stress at elastic limit	*lb./sq. in.*	1,350	1,060	1,200

			Maximum.	Minimum.	Mean.
Shearing parallel to grain :					
Shearing strength :					
Surface of failure	Radial	*lb./sq. in.*	1,700	1,350	1,510
	Tangential	"	1,530	1,250	1,440
Cleavage :					
Splitting strength :					
Surface of failure	Radial	*lb. per inch width*	361	233	281
	Tangential	" "	362	222	301
Tension perpendicular to grain :					
Tensile strength :					
Surface of failure	Radial	*lb./sq. in.*	723	521	597
	Tangential	"	781	534	642
Hardness :					
Load required to imbed a 0·444 inch steel sphere to one-half its diameter :					
Radial surface . . .		*lb.*	1,260	780	1,000
Tangential surface . . .		"	1,340	840	1,070
End surface		"	1,350	1,020	1,200
Specific gravity			0·638	0·510	0·560
Moisture		*per cent.*	29·4	11·8	17·3
Weight per cubic foot . . .		*lb.*	49·3	36·7	41·8

Results of Working Tests

(1) *Sawing.*—The wood cuts fairly readily with hand and machine saws.

(2) *Planing.*—It planes easily, but "picks up" on a radial surface.

(3) *Boring.*—All boring tools work fairly easily and give good results.

(4) *Nailing and Screwing.*—Nails and screws can be driven in easily and hold firmly; the wood does not split.

(5) *Working with Gouge and Chisel.*—The wood cuts readily, but there is a tendency to tear up.

(6) *Mortising and Dovetailing.*—The wood cuts rapidly and cleanly in the mortising machine; joints have only moderate strength as the wood is fairly soft.

(7) *Turning.*—The wood cuts easily in the lathe and an excellent finish is obtainable with sand-paper.

(8) *Glueing.*—The glue adheres well.

(9) *Polishing.*—Good results can be obtained.

(10) *Staining and Varnishing.*—Satisfactory results are obtained.

Remarks

Penkwa is a firm wood of moderate weight. It works readily with most hand and machine tools and finishes well.

It has good strength in transverse bending and in compression parallel to the grain, and is fairly stiff. Its resistance is fairly good to shearing ; moderate to compression and tension perpendicular to the grain ; and rather low to cleavage.

The Advisory Committee on Timbers furnished the following report on the possible uses and value of the timber.

This timber is one of the so-called " cedars " or " scented mahoganies " imported from West Africa. It bears a general resemblance to plain Sapele mahogany and would serve for most ordinary purposes where an unfigured second-grade mahogany is employed. Timber of the quality of the sample examined would probably need care in finishing with the plane and also in polishing.

Penkwa would doubtless find many uses locally, and in this country is suitable for the less expensive types of furniture and cabinet work and for interiors (backs, linings and drawer-bottoms) in higher-class work. The remarks made by the Committee regarding the uses and market prospects of Baku (*Mimusops* sp.) may be taken as applying also to Penkwa (see p. 430).

7. KONKRUMA (? *MORINDA CITRIFOLIA*)

The specimens received consisted of two planks, 12 ft. long, 20 and 24 in. wide, and 3 in. thick ; they were cracked at the ends, but otherwise the wood was in sound condition.

The heartwood was brown, darkening slightly on exposure, and the sapwood was light yellowish-brown, about 3 in. wide ; the boundary was not very definite. The grain was alternating spiral, moderately coarse and fairly open.

In *transverse section* the wood was dark brown and the sapwood light brown. The pores were of moderate size, numerous, often in radial groups of two or three, and

occasionally having slight red contents. The rays were visible as numerous, pinkish-brown, fine lines normally about a pore-width apart. The rings averaged nine to the inch and were indicated by their boundaries, which were fine, pinkish-brown lines of soft tissue, and by a narrow, slightly darker zone corresponding to the later growth wood.

In *radial section* the wood was pinkish-brown and the pores appeared as narrow, brownish grooves occasionally partially filled with a red substance ; the appearance of the section was typical of wood having alternating spiral grain. The rays were seen as numerous, pinkish-brown bands usually having fine, dark border lines. The rings could be distinguished by narrow, darker-shaded bands and by the fine lines of soft tissue.

In *tangential section* the wood was light brown and the pores appeared as long, brownish grooves. The rays were visible as innumerable, short, reddish-brown lines tapering at the ends, and often having a dark speck at the ends. The rings were indicated by undulating, narrow bands of soft tissue and of the darker-shaded wood.

Results of Mechanical Tests on Air-dry Timber

		Maximum.	Minimum.	Mean.
Static bending :				
Maximum calculated longitudinal shear	*lb./sq. in.*	534	472	501
Fibre stress at elastic limit	,,	10,800	9,170	9,850
Modulus of rupture	,,	15,160	13,540	14,340
Modulus of elasticity	,,	1,910,000	1 434,000	1,770,000
Work in bending to elastic limit	*inch-lb./cu. in.*	3·38	2·38	2·84
Work in bending to maximum load	,, ,,	15·1	11·0	13·0
Compression parallel to grain :				
Fibre stress at elastic limit	*lb./sq. in.*	4,770	3,900	4,270
Maximum crushing strength	,,	7,960	7,330	7,710
Modulus of elasticity	,,	2,530,000	1,905,000	2,143,000
Compression perpendicular to grain :				
Fibre stress at elastic limit	*lb./sq. in.*	1,305	1,100	1,195
Shearing parallel to grain :				
Shearing strength :				
Surface of failure: Radial	*lb./sq. in.*	1,785	1,215	1,560
Surface of failure: Tangential	,,	1,930	1,535	1,724

		Maximum.	Minimum.	Mean.
Cleavage :				
Splitting strength :				
Surface of failure { Radial	*lb. per inch width*	448	404	429
Surface of failure { Tangential	„ „	448	348	382
Tension perpendicular to grain :				
Tensile strength :				
Surface of failure { Radial	*lb./sq. in.*	818	537	705
Surface of failure { Tangential	„	1,082	560	764
Hardness :				
Load required to imbed a 0·444 inch steel sphere to one-half its diameter :				
Radial surface . . .	*lb.*	1,350	1,000	1,170
Tangential surface . .	„	1,480	1,010	1,250
End surface . . .	„	1,930	1,210	1,570
Specific gravity		0·611	0·529	0·561
Moisture	*per cent.*	27·9	11·8	16·0
Weight per cubic foot . . .	*lb.*	43·8	38·0	41·0

Results of Working Tests

(1) *Sawing.*—The wood cuts moderately easily with hand and machine saws.

(2) *Planing.*—There is a tendency to " pick up " on a radial sawn surface, but otherwise the wood planes fairly readily.

(3) *Boring.*—Gimlets and bradawls work fairly easily and give good results ; the wood has very little tendency to split. Centre and augur bits cut cleanly with moderate ease.

(4) *Nailing and Screwing.*—Nails and screws can be driven in fairly readily and hold firmly ; there is little tendency to split.

(5) *Working with Gouge and Chisel.*—The wood cuts easily, but there is a slight tendency to tear up.

(6) *Mortising and Dovetailing.*—The wood can be cut fairly cleanly and moderately easily in mortising machine. Strong joints are obtainable.

(7) *Turning.*—It cuts readily in the lathe, giving a fair surface with tools and a good finish with glass-paper.

(8) *Glueing.*—Fairly strong joints are obtainable.

(9) *Staining.*—The wood takes stain fairly well.

(10) *Polishing and Varnishing.*—The wood requires filling, but good results are obtainable.

Remarks

Konkruma is a moderately hard wood of medium weight. It can be worked fairly easily with most hand and machine tools and with care it finishes well.

It is fairly stiff and has a moderately high bending and crushing strength; its resistance to compression and tension perpendicular to the grain and to cleavage is moderate, whilst its shearing strength is fairly good.

The Advisory Committee on Timbers furnished the following report on the possible uses and value of the timber.

This timber, although (it is understood) belonging to a different botanical family, is similar to Penkwa in texture and general character, but is without the marked scent of that timber. It is darker, has a straighter " row," and shows an attractive mottling.

The Committee regard this timber as having a very good appearance and as being suitable for cabinet work and furniture-making requiring a timber with a useful degree of " ornament."

Konkruma would no doubt serve satisfactorily as a mahogany substitute both in the Gold Coast and in this country. The general uses of timbers of this character, and their market prospects, have been mentioned in the Committee's report on Baku (see p. 430).

NEW OIL-SEEDS FROM TANGANYIKA

1. *TRICHODESMA ZEYLANICUM* SEED

The sample of seed which is the subject of this report was forwarded recently for examination to the Imperial Institute by the Director of Agriculture, Tanganyika Territory. It was stated that the plant is a weed common in the Morogoro district, growing in abundance on old cotton fields and waste land. It was desired to ascertain whether the oil present in the seed would be of value and whether a market could be found for the seed.

Specimens of the plant were at the same time forwarded from Tanganyika to the Director of the Royal

Botanic Gardens, Kew, and the Imperial Institute has been informed that these have been determined as *Trichodesma zeylanicum*, R.Br. (Nat. Ord. Boraginaceæ).

The sample consisted of small seeds, which were clean and in sound condition ; they had a brittle husk and a soft, cream-coloured kernel.

The seeds were found to contain 9·2 per cent. of moisture and on extraction with light petroleum they yielded 28·7 per cent. of oil, corresponding to a yield of 31·6 per cent. from the moisture-free seeds.

The oil thus extracted from the seeds was a golden yellow liquid, and, when spread on glass, dried in six days to a soft film.

The oil furnished the following constants :

Specific gravity at 15/15° C.		0·9298
Refractive index at 40° C.		1·471
Solidifying point of fatty acids		22·0° C.
Acid value [1]		0·3
Saponification value [1]		192·0
Iodine value (Hübl, 17 hrs.)	*per cent.*	161·1
Unsaponifiable matter	*per cent.*	0·6

[1] *Milligrams of potash (KOH) for 1 gram of oil.*

The residual meal left after the extraction of the seeds with light petroleum was of greyish-cream colour and had a bitter taste. On chemical analysis it gave the following results, which are (1) expressed on the meal as prepared in the laboratory, containing only 0·3 per cent. of fat, and (2) calculated for the material when containing 7 per cent. of fat.

	(1) *Per cent.*	(2) *Per cent.*
Moisture	12·1	11·3
Crude proteins	18·1	16·9
Fat	0·3	7·0
Carbohydrates, etc. (by difference)	33·6	31·3
Crude fibre	20·1	18·8
Ash	15·8	14·7
Nutrient ratio	1 : 1·9	1 : 2·8
Food units	80	91

The meal did not contain any cyanogenetic glucosides, but it gave reactions indicating the presence of an alkaloid.

These results show that *Trichodesma zeylanicum* seeds

contain a fair proportion of oil, which belongs to the class of drying oils.

The residual meal left after the extraction of the oil contains a good percentage of proteins, but rather high proportions of fibre and mineral constituents, and has only a moderate nutritive value. It has a bitter taste and contains a substance of an alkaloidal nature, and is therefore not likely to be of value as a feeding-stuff. It could be utilised as a manure, but for this purpose would only realise a very low price.

Commercial Value

A firm of oil-seed crushers to whom a sample of the seed was forwarded stated that the oil was of good colour and had a pleasant nutty taste ; when refined, it might possibly be suitable for use as an edible oil, but it could not be employed for the manufacture of margarine or compound fats. The firm expressed the opinion that, owing to the low melting-point of the fatty acids, the oil would probably not find a market for the manufacture of hard soap, but it might be used for soft soap or as a substitute for linseed oil in the cheaper paint trades.

It was considered that the residual cake left on crushing the seeds would be unsuitable for use as a feeding-stuff owing to its bitter taste and the large proportion of siliceous matter present, derived from the husks.

In view of these facts the firm estimated that the market value of such seed at the present time would be about £9 to £9 10*s*. per ton, delivered to United Kingdom ports. They added that if the quantities of seed available are sufficiently large to be of importance in the development of the Territory, they would be glad to make a commercial trial if a consignment of 50 tons could be forwarded for the purpose.

General Conclusions

The seeds of *Trichodesma zeylanicum* contain 28·7 per cent. of an oil which possesses drying properties. It might be utilised for the manufacture of cheap paint, soft soap, or, when refined, as an edible oil.

It is a question for consideration in Tanganyika

whether the comparatively low value of the seed would make its collection from the wild plants remunerative or whether it would be worth while to produce the seed as a cultivated crop. It was suggested to the authorities that if it appears that the seed could be regularly supplied in large quantities at the above-mentioned price, a preliminary consignment of 50 tons might be forwarded for crushing trials as proposed.

2. *Commiphora zanzibarica* Fruits

A sample of the fruits of *Commiphora zanzibarica* var. *elongata*, Engl. (Nat. Ord. Burseraceæ), was forwarded recently by the Director of Agriculture, Tanganyika, for examination. It was stated that the fruits are produced in great profusion in the Territory and it was desired to ascertain their possibilities as a source of oil.

The sample consisted of fruits free from the exocarp. They were small and oval-shaped with pointed ends, and had a hard thin shell (endocarp), of which nearly half was covered with a soft, red, firmly-adhering, aril-like body (mesocarp). The endocarp had a large and a small loculus, one seed maturing in the larger one. The seeds were soft and cream-coloured. In about 10 per cent. of the fruits the seeds were either absent or withered.

The average dimensions and weights of the fruits and seeds were as follows:

	Average Length. *cm.*	Average Breadth. *cm.*	Average Weight. *grams.*
Fruit	1·6	1·0	0·43
Seed	1·0	0·8	0·15

The fruits consisted of "aril" 20 per cent., shell 48 per cent. and seed 32 per cent. A quantity of seed was separated from the fruits for examination, but in view of the firm adherence of the "aril" to the shell these two portions were treated together.

Oil.—The seeds contained 4·8 per cent. of moisture, and on extraction with light petroleum yielded 55·1 per cent. of oil, equivalent to 67·9 per cent. calculated on the moisture-free seeds and to 18·7 per cent. on the moisture-free fruits. The oil was clear, pale yellowish-brown and had a nutty taste and a not unpleasant odour.

The " aril " and shell contained 6·4 per cent. of moisture, and on extraction with light petroleum furnished 21 per cent. of oil, equivalent to a yield of 22·4 per cent. expressed on the moisture-free material and to 15·2 per cent. on the moisture-free fruits. This oil was of red colour, had a disagreeable taste and odour, and was somewhat turbid owing to the presence of stearins.

On chemical examination the two oils furnished the following results; the corresponding figures for cotton-seed oil are added for comparison:

	Oil from Seeds.	Oil from Shell and " Aril."	Cotton-Seed Oil[3]
Specific gravity at 15/15° C.	0·9223	0·929	0·922–0·925
Refractive index at 40° C.	1·465	1·459	1·465
Solidifying point of fatty acids	32·7° C.	34·9° C.	33°–38° C.
Acid value[1]	0·7	7·9	—
Saponification value[1]	188·6	201·2	192–195
Iodine value, Hübl, 17 hrs. *per cent.*	106·8	57·4	105–115
Unsaponifiable matter *per cent.*	1·28	0·64	0·8–1·8
Volatile acids, soluble[2]	0·11	0·27	—
Volatile acids, insoluble[2]	0·30	0·43	—

[1] *Milligrams of potash (KOH) for 1 gram of oil.*

[2] *Cubic centimetres of decinormal alkali required to neutralise the acids from 5 grams of oil.*

[3] *Bolton and Revis, " Fatty Foods," p. 216.*

The results show that both the seeds and the " arils " contain a large proportion of oil. The seeds yield about 58 per cent. of oil and the " arils " (assuming that the shells contain no oil) about 75 per cent., calculated in each case on the moisture-free material.

The two oils are quite distinct in general characters and also show considerable differences in their chemical constants, especially in the case of the iodine value.

The seed oil resembles cotton-seed oil in its chemical constants with the exception of the saponification value, which is rather lower than that of the latter oil. This oil, if carefully refined, would probably furnish a satisfactory edible oil. The production of the seed oil on a commercial scale would, however, depend on the possibility of separating the seeds from the shell and " aril " by some form of decorticator. The presence of " arils " among the seeds would seriously impair the quality of the oil.

If it is found impracticable to separate the seeds from

the fruits efficiently, the whole fruits could be treated by crushing or extraction for the preparation of oil, but in view of the inferior quality of the aril oil, the oil from the whole fruits would only be of low value. The results given in this report show that the dry fruits would yield about 35 per cent. of oil.

Meal from the Seeds.—The meal left after the extraction of the seeds with light petroleum was of cream colour and had a very slight and not unpleasant taste. On analysis it yielded the following results:

	Per cent.
Moisture	10·5
Crude proteins	61·7
Fat	0·6
Sugars, ready-formed reducing	nil
Sugars, reducing only after inversion	2·7
Starch (by acid hydrolysis)	nil
Other carbohydrates, etc. (by difference)	10·5
Crude fibre	3·4
Ash	10·6
Nutrient ratio	1 : 0·24
Food units	169

The meal is free from alkaloids and cyanogenetic glucosides. It contains a high percentage of crude proteins and would probably form a valuable feeding-stuff if available in quantity.

Meal from the Shells and "Arils."—The meal left after the extraction of the shells and " arils " with light petroleum was of buff colour and possessed an unpleasant acid taste. On analysis it furnished the following results:

	Per cent.
Moisture	7·6
Crude proteins	4·7
Fat	0·8
Sugar, ready-formed reducing	1·3
Sugars, reducing only after inversion	nil
Starch (by acid hydrolysis)	16·7
Other carbohydrates (by difference)	21·3
Crude fibre	41·7
Ash	5·9
Nutrient ratio	1 : 8·8
Food units	53

The meal is free from alkaloids and cyanogenetic glucosides. It contains a very small quantity of crude

proteins and a high percentage of fibre. On account of its low nutritive value and its unpleasant taste the meal is not likely to be of value as a feeding-stuff.

Commercial Value of the Fruits

Oil-seed crushers to whom a sample of the fruits was submitted expressed the following opinions.

The whole fruits would be worth very little on account of the objectionable nature of the shell, but if it were possible to obtain the seeds free from the shells they would be worth about £18 per ton in the United Kingdom. The oil from the seeds is similar to cotton-seed oil and of good quality, and would probably suffer little loss on refining; the cake would be useful as a concentrated feeding-stuff or as a rich manure. Owing, however, to their soft nature, the seeds would probably deteriorate rapidly in storage or during transit, and decortication would therefore have to be carried out at the oil-mill; this would entail a considerable expenditure on freight as the shells would be of little or no value.

If decortication should prove impracticable, the whole fruits would have to be treated. The oil from the whole fruits has an unpleasant taste and a bright red colour which is very difficult to remove, and it could only be utilised for the manufacture of lubricating greases or for the production of fatty acids and stearins. For such purposes the oil would be worth only about £25 per ton and the fruits not more than £6 per ton delivered to a United Kingdom port.

General Conclusions

The results of this investigation indicate that the prospects of utilising the fruits of *Commiphora zanzibarica* as a source of oil are not very promising. The seeds themselves would be of value if they could be successfully separated from the fruits, but for this purpose a special form of decorticator would be necessary. In any case, decortication would be difficult in view of the nature of the shell and the soft character of the seed, and would have to be carried out at the oil-mill immediately before pressing the seed. The alternative plan of crushing the

whole fruit would yield an oil and cake of low value, and if treated in this way the fruits would not be worth more than £6 per ton in the United Kingdom.

In these circumstances it seemed desirable that information should be furnished as to the quantities of fruits which are available annually in Tanganyika, and the price which would make their collection and export remunerative. When these particulars are available it will be possible to judge whether further action can usefully be taken.

TANNED GOAT SKINS FROM TRAVANCORE

Six goat skins, tanned in Travancore, were forwarded recently to the Imperial Institute by the Director of Industries in that State, in order to ascertain whether such tanned skins would find a market in London and, if so, the approximate prices they would be likely to realise. Samples Nos. 1, 2 and 3 had been tanned with Konna bark (*Cassia fistula*), and Nos. 4, 5 and 6 with Thumpagam bark (*Hopea parviflora*). A report on the tanning properties of a sample of the latter bark from Travancore will be found in this Bulletin (1925, **23**, 162).

The approximate weight and dimensions of the skins were as follows:

	oz.	in.
No. 1	8½	24 × 20
" 2	10	24 × 18
" 3	11½	25 × 20
" 4	6	19 × 15
" 5	8	23 × 16
" 6	13	23 × 19

The leather was of buff colour, fairly soft, firm and rather coarse-grained. The skins tanned with Thumpagan bark were somewhat softer than those tanned with Konna bark.

The skins were submitted to brokers for an opinion regarding their quality and probable value. The firm reported that the pelts had been fleshed fairly clean and had been well trimmed. The tanned skins are, however, much inferior to those of the South Indian tanneries,

especially in colour, which is too dark to render them suitable for the light shades of leather now in demand. The skins are also rather brittle, this defect being more marked in the case of the Thumpagam tannage than in that of the Konna tannage, and crack more or less easily.

In order to ascertain the values of the skins the brokers sent them to a firm of leather dressers to be dyed and finished. The trials showed that the skins tanned with Thumpagam bark take the dye better than those tanned with Konna bark, and that the brittleness of the skins was effectually overcome in the finishing processes. On the basis of these results, the brokers stated that the skins tanned with Thumpagam bark would be worth 3*s*. 4*d*. to 3*s*. 6*d*. per lb. in London at that time (January, 1926) whilst those tanned with Konna bark would realise 3*s*. to 3*s*. 2*d*. per lb. At these prices such skins would find a ready market if shipped in sufficiently large quantities, say from 8,000 to 10,000 skins at a time, whereas small consignments of 1,000 to 2,000 skins would probably not realise so high a price.

The results of this enquiry show that these tanned goat skins from Travancore are of satisfactory quality, although rather dark-coloured, and that they would be readily saleable in London.

ARTICLE

THE CYPRUS SILK INDUSTRY

By Norton Breton, M.B.E. (Milit.)

Member of the Imperial Institute Advisory Committee on Silk Production

Readers of this Bulletin will have learned, from time to time, of the activities of the Imperial Institute Advisory Committee on Silk Production in regard to Cyprus. This island was prominent from the outset of the Committee's enquiries in 1916 as affording a useful field for the development of a native silk industry. The Committee set to work to obtain information regarding the state of the

industry and was eagerly supported in its enquiries by the Cyprus Department of Agriculture. As a result, at the end of the Great War, much valuable information had been collected, which was sufficiently promising to encourage the Committee to follow up their enquiries with practical trials.

The Committee found that there existed in Cyprus an important silk cocoon industry. The cocoons were being produced in small quantities by the peasants, and local merchants were collecting them and treating them in the necessary way in order to export them to France or Italy. It was found, also, that over a series of years the prices paid to the peasants were not on an attractive or remunerative basis, with the result that the industry was more or less in a languishing condition. The exported cocoons, when they arrived in France or Italy, were usually snapped up readily by buyers who evidently appreciated their good quality. The cocoons, however, lost their identity and probably went to swell the productions of "French" or "Italian" silk.

All this pointed to the urgent need for an establishment to reel the cocoons into silk on the spot—a Silk Filature, as it is called in the industry—and the Committee initiated the practical trials referred to above with a view to gaining such further knowledge as could be placed at the disposal of anyone wishing to take up the enterprise.

Cocoons were obtained through the Cyprus Department of Agriculture and a member of the Committee arranged for them to be reeled in France. The raw silk produced from the reeling was distributed for throwing and weaving trials to other members of the Committee and the waste silk from these trials was spun by another member. The reports were so satisfactory that it became evident that Cyprus silk, as such, had characteristics of its own and that the Island cocoons were capable of being reeled into a first-class grade of thread. All this research, so easily mentioned in a few words, took some three or four years to carry out and entailed a great deal of attention from the Committee. The different stages of the experiments were, fortunately, under the eye of individual

members, and at no time was the Committee compelled to go outside its own membership for technical information.

In the course of the experiments, a particularly handsome piece of damask was woven by the Chairman of the Committee and was placed on exhibition at the Institute. This happened to catch the eye of Her Majesty the Queen during one of her periodical visits to the Imperial Institute, and she was pleased to display the greatest interest when she was informed that the raw material from which the cloth was made had its origin in the youngest of His Majesty's possessions. Always ready to seize any chance to further the interests of the Empire, Her Majesty was pleased to command that a quantity of damask be specially woven from Cyprus cocoons for the purpose of decorating one of the State Rooms at Buckingham Palace. This gracious act on the part of Her Majesty was not long in being reported in Cyprus, with the happy result that direct attention was focussed on the silk industry, the people began to take new courage from the fact that their small corner of the world had been so distinctly favoured, and they continue to refer with pride to this incident in their short industrial history.

Such, in short, was the position of the Committee's work in regard to Cyprus, and it had reached a stage where more could not be profitably done in that direction. In fact, the enquiry had arrived at the parting of the ways. The Imperial Institute had done its part ; it was for the commercial community to profit by it. Any further action must be transferred from Kensington to the City.

A firm engaged for many years in the reeling of raw silk became interested, and the information collected by the Committee was placed at its disposal. Negotiations were set on foot and, after two years, reached a stage sufficiently promising for a representative to be sent out to study the industry on the spot. He was able to report favourably, and necessary arrangements were made for the establishment of an up-to-date Silk Filature to reel Cyprus cocoons on the spot.

In June 1925 a site was chosen, and the first sod was

turned on July 13. The Filature began operations on March 25, 1926—a little over eight months being occupied in erecting the group of buildings and in making, shipping and erecting the machinery. To anyone acquainted with Cyprus and its people, it will be evident that this was no mean achievement, and credit must be given to the Cypriot contractor for his courage in undertaking a work the magnitude of which was hitherto unknown in Cyprus, and for the energy and enterprise he displayed in fulfilling his contract promptly. The buildings, as will be seen from the accompanying illustrations (Plates I and II), are solidly constructed and afford a good example of Cypriot masonry—an art to a great extent forgotten in latter-day Western Europe. The main building consists of the reeling hall, 180 ft. long, 33 ft. wide, and 16 ft. high to eaves, with ample air space and ventilation for the 150 workers who are engaged in the reeling of the silk; a room for the examination of the silk; engine room and boiler house; accumulator room; office and cocoon-issuing room. In addition, there is a large store 200 ft. long for storing the cocoons, built of stone with cement floor and reinforced concrete roof, making it fireproof and rat-proof; a reservoir for water to contain 150,000 gallons; a shed housing the séchoir or dryer; and three dwellings to house the manager and his staff.

The site chosen for the Filature is on the outskirts of the village of Yeroskipos (Holy Garden), situated about 3 miles from the port of Paphos in the extreme south-western corner of the Island. It is 100 miles from Nicosia, the capital, and 45 miles from the chief port, Limassol. These are disadvantages, but, on the other hand, the district of Paphos produces roughly half the total of cocoons in Cyprus, and Yeroskipos also is blessed with that rare commodity in Cyprus, an ample supply of water. Moreover, the water proved to be excellent for silk-reeling, which many waters are not.

After a period of preliminary training of the workers, the Filature was formally opened by the Governor, Sir Malcolm Stevenson, K.C.M.G., on Empire Day, May 24, 1926. His Excellency took a keen interest in the negotiations while the project was still under discussion and did

PLATE I.

CYPRUS SILK FILATURE.

GENERAL VIEW TAKEN FROM MANAGER'S HOUSE.

Overseer's House in foreground, beyond that the Drying Shed and Cocoon Store (flat-roofed). Engineer's House at end of road. On left, the Reservoir, Boiler House, Reeling Hall and Silk Examining Room.

Plate II.

CYPRUS SILK FILATURE

Fig. 1.—Reeling Hall

Fig. 2.—Silk Examining Room

all in his power to smooth over difficulties as they arose. Persuaded, as he was, that the erection of the Filature would give a great stimulus to the cocoon industry and ultimately benefit the peasant, he allowed no obstacle to stand in the way of its realisation, provided that it could be reasonably and fairly removed.

The collection of the cocoons was in full swing at the date of the official opening and the Governor was thus able to see all the processes through which the cocoons and silk go before the latter is finally despatched to Europe for weaving.

A short description of the silk industry may be of interest. Cocoon raising is essentially a cottage industry. It is difficult to carry it on by one firm under the mass production principle owing to the enormous space required by the silkworms during the feeding period. The production of cocoons, therefore, is best left to the peasant who raises a small quantity and devotes a room or two in his own house to the worms. It is only necessary to state that about 8,000 peasants would be engaged in producing sufficient cocoons for one average-sized filature to give an idea of the space required to feed the worms for such a production.

The peasant procures for himself a quantity of silkworm eggs. According to the number of mulberry trees he possesses he buys anything from ¼ oz. to 2 oz. These eggs, called technically "seed," are either produced locally by experts engaged in this special business or are imported from France or Italy. The seed, as it will now be called, is microscopically examined for the detection of any of the diseases to which silkworms are prone. If, during examination, disease manifests itself, all the seed from that particular lot is destroyed, as strict Government regulations exist to prevent the sale of disease-infected seed.

As soon as the mulberry trees begin to show signs of budding, the peasant starts to incubate his seed. In Cyprus this is mainly done by the primitive fashion of imparting to the seed the necessary heat by contact with the human body, with the result that incubation is irregular and unduly protracted. Simple incubators are in

use in Europe which make incubation regular and the eggs all hatch out together, which is a great advantage, as will be seen later. This is one improvement that the establishment of the Filature in Cyprus may bring in its train.

The seed has now become thousands of minute worms which require nourishment. Young and tender mulberry leaves are collected and chopped to the fineness of mint in mint-sauce. This pulp is spread lightly over the worms and is consumed. After 3 or 4 days the worms are sufficiently grown to be able to consume whole young leaves, and from this time onwards their powers of consumption run parallel with the maturity of the mulberry. The feeding lasts about 42 days, but during that time the worms pass through four periods of sleep lasting 24 hours each. During this time the skin of the worm cracks and when the creature wakes up it is able to shed the old skin and continue with a new skin which nature has provided. The importance of the regularity of hatching out, mentioned above, now becomes apparent. The worms hatched out on the same day all sleep at the same time, and during that period do not require nourishment. If, however, the hatching out is irregular, sleeping and active hungry worms are mixed up, with the risk either of a waste of mulberry leaf, or of malnutrition of the active worms. It must be remembered the worms will not touch faded leaves; the latter must be quite green and fresh.

After the fourth sleep, the worms, which have now grown to about 1½ in. in length and in girth about the size of an ordinary penholder, start their great and final feed. It is calculated that in the 10 days concerned they consume about twenty times their own weight of leaves and they grow rapidly to the size of a little finger.

The peasant must now provide the structure on which the worms can spin their cocoons. This consists of "bushes" of scrub-oak or other many-branched shrub which are placed vertically on the shelves on which the worms have hitherto spent their lives. Obedient to the dictates of nature, the worms, now replete with glutinous fibre, mount up into the bushes and proceed to spin the cocoons around themselves. After 8 or 9 days, the bushes are

removed and the cocoons collected and placed in baskets. The peasant takes them to market and sells them to the highest bidder, and with that ends the peasant's share in the industry. Here, again, the importance of an even incubation may be seen, for if the hatch-out was irregular, some worms would be ready to spin before others and the peasant would run the risk of taking down the bushes before all the worms had completed their spinning. This would mean cocoons of inferior quality. On the other hand, he dare not wait more than 8 or 9 days, otherwise the chrysalis, as the worm has now become, will complete its stage and change into a moth, which in emerging will cut through the silk fibre of the cocoon and destroy it for reeling purposes and thus render it practically valueless.

The buyer of the cocoons from the peasant has now to treat them so as to prevent the chrysalis from turning into a moth, which would cut through the cocoon. The worm spins the cocoon with one continuous thread in a manner forming the figure 8, therefore the cutting of the cocoon at one end means the cutting of the one continuous thread into many thousand short ones and naturally makes it impossible to unwind. "Reeling silk" is only another way of saying "unwinding cocoons." The problem is to destroy the chrysalis inside the cocoon without damaging the cocoon, and the only method so far discovered is suffocation. Leaving cocoons exposed to the hot sun will suffocate the chrysalis, but it also harms the thread of the cocoons. That is the most primitive method. The next method is that practised hitherto in Cyprus—suffocation by steam. The cocoons are placed on shallow shelves in a cupboard which is constructed over a common washing copper. A fire is lit below the cauldron, which is filled with water, and steam is generated. The cocoons remain in the steam from 8 to 10 minutes and the chrysalis is suffocated. The cocoons then have to be spread lightly on canvas beds, sheltered from the sun, but where wind and air can circulate freely. They have to remain on the beds from 6 weeks to 2 months, during which time they require to be turned over twice daily. The dead chrysalis thus gradually dries up without becoming decomposed. In this method there is the danger of either keeping the cocoons

too long in the steam and destroying the fibre of the cocoon, rendering the thread brittle, or not keeping them long enough, which means that the moth cuts through after all.

The safest and most practical method is suffocation by hot air. Séchoirs, or dryers, are constructed to take a large quantity of cocoons at one charge, and air is fanned through a steam-coiled chamber rendering it about 200° Fahr. The hot air circulates by means of channels through the chambers containing the cocoons, and the chrysalis is suffocated and all moisture in it dried up in one process of 12 hours' duration. The Filature in Cyprus is equipped with a dryer of this type, and the cocoons can be put into sacks and stored without fear of deterioration. Exposure to air and wind, which also means exposure to dust and dirt, is unnecessary, and the colour of the silk when the cocoons are reeled is brighter, while the water used in the reeling keeps clean. These séchoirs can only be worked economically by concerns dealing with cocoons on a large scale, though smaller plants are now being made for the small cocoon merchants to replace the old steam cupboard.

The cocoon season lasts about one month in Cyprus, say, May 25 to June 25, so sufficient cocoons are bought during that period to cover the requirements of the Filature for the whole year up to the following May 25. As it stands at present, the Filature consists of 80 reeling basins at each of which 8 skeins can be reeled at one time, but the plant has been designed to render duplication simple and economical. Eighty basins can cope during the year with about 370,000 lb. of " fresh " cocoons and the production of Cyprus at present is about 450,000 lb. There is, however, a local rough-reeling and weaving industry which absorbs a large proportion of the excess. So the Filature is just about equal to taking the Island's exportable production. It may here be mentioned that since the building of the Filature was started, it is estimated that 60,000 new mulberry trees have been planted and probably more will follow. This increase in leaf should enable production to double itself in 4 or 5 years, and the Filature will, no doubt, carry out the duplication in good time to meet this increase.

All the labour employed in the silk reeling is female. Out of a total of 180 workers, not more than 5 or 6 are males. In the reeling hall itself, there are 80 reelers, 40 girls who prepare the cocoons for the reelers, 16 girls between the reelers and reels who repair breaks in the thread, and 14 others dealing with waste products. About 15 girls are engaged in the silk room, where testing takes place, the thread is examined and defects are removed. The staff consists of about 12 members.

The machinery of the Filature in connection with the silk reeling and the drying of cocoons is Italian. It is delicate and requires little power to run. British engineers do not touch this branch of industry, which is natural, for silk-reeling is not carried on in the United Kingdom. The Italians and the French have made a close study of its requirements and the improvement in reeling plant within the last few years has made great strides, particularly in Italy. The electrical installation for lighting and power is entirely British.

It has been seen how the cocoons are produced and dealt with to render them a marketable commodity, and a few words may now be devoted to a description of the process of silk-reeling. First of all, the dried cocoons must be sorted into different qualities. During the transport of " fresh " cocoons, i.e. while the chrysalides are alive, there is bound to be a certain amount of crushing of cocoons. One cocoon thus crushed may be the cause of staining several others. Also, there are worms which make their cocoons but die in the process, others which die when their cocoons are only partly completed. A black fluid is exuded from some of these cocoons, which, in turn, stain all the cocoons in their vicinity. There are also cocoons spun by worms which have been ill fed; these are weak in the thread and contain less silk. The sorting is done by hand, and the cocoons separated into four qualities, (*a*) cocoons which are perfectly clean and firm, (*b*) cocoons which are otherwise firm but have been stained from without, (*c*) weak cocoons and slightly stained cocoons in which the worm has died, and (*d*) cocoons crushed and badly stained from within. The (*c*) and (*d*) qualities, which form but a small proportion of

the whole, are reeled off as quickly as possible, as they are liable, if kept in store, to attack from a weevil which bores a minute hole about the size of a pin's head through them and renders them unsuitable for reeling. The (*b*) quality, which forms about 20 per cent. of the whole, is also susceptible to the weevil, but to a much smaller degree, so these are worked next, leaving the (*a*) quality for the remainder of the year's work.

Each of the 80 reelers has a basket with a certain weight of cocoons issued to her daily. The girl who prepares the cocoons for the reeler places a quantity of them in a round deep basin with water kept at a certain level automatically and heated to boiling point by a steam coil in the bottom. A circular broom made to fit exactly over the basin is shut down on the soaking cocoons (which float on the surface) so that the ends of the bass just touch the tops of the cocoons. This broom is set to work in a circular motion first one way and then the other until the ends of the broom have caught the outside fluff of the cocoons and the actual reeling thread is found. The girl then catches up the cocoons by means of a strainer —a sort of frying-pan with holes in it—and passes them over to the reeler. The latter empties them into the reeling basin with water at about 200° Fahr. She then "makes her threads." She is going to reel eight separate skeins, so she has eight threads to make. She takes the threads from about six cocoons and makes one thread of them by twisting them together. This passes through an apparatus about 2 in. above the water level, thence upwards about 18 in. round a tiny glass reel, then downwards round a similar glass reel and upwards again until it crosses itself. Here it is twisted round itself many times and then goes through a glass conducting hook above the reeler's head and is finally tied to a large reel about 4 ft. behind her. She repeats this process until all the eight threads, consisting of the threads of six cocoons each, are ready. Her preparation for the day's work is now completed and she starts work by setting the large reels revolving by means of a control ready to her hand, and as the reels revolve they pull the threads; the 48 cocoons begin to dance about in the water as they unwind

thems ves in response to the pulling of the reels. When the th ad is in motion it runs through the twist on itself described above, and the tension is so strong that all the moisture on it from the water in the basin is expelled in the form of spray and the thread reaches the large reel practically dry. The question may be asked, How can such a fine thread (it is only just visible to the naked eye) bear such a strain upon it? The hot water dissolves the "gum" which makes the thread stick together when the cocoon is formed and renders the silk tenacious and elastic. A good silk should stretch about a third of its own length before reaching breaking point. Thus 48 cocoons are unwinding at the same time, but cocoons give off all their silk in time and breaks continually occur, so the reeler has to watch her eight groups carefully and directly she detects a cocoon that is motionless, she supplies the thread of another from a reserve which she keeps ready and returns the motionless cocoon, if it is not finished, for another brushing. The apparatus through which the thread was originally passed has a little disc attached to it which revolves swiftly. This disc cuts the new thread supplied by the reeler and whirls it round the other five threads and the new cocoon is drawn through the water until it reaches its group. While the reeler has been dealing with the first bunch of cocoons, another bunch is in preparation for her, and so the process goes on throughout the day until the basket of cocoons issued to her has been exhausted. The eight skeins are then removed from the reels and taken to the silk room.

On arrival in the silk room, the skeins are weighed and a ratio to the quantity of cocoons used is found. This is an important item in Filature management, for it is largely in this respect that the difference between profit and loss arises. Too much brushing or too much movement by the reelers' hands can result in good pure thread passing into the fluff or waste. If the price of silk is 25*s.* per lb., the waste fetches only about 5*s.* per lb., so the loss is obvious and a very strict control has to be exercised.

After weighing, the silk is passed to examiners, who place it on stands where the skeins can be opened out and examined for any defects. These consist of small knobs

on the thread like pin-heads, or a coarse piece 3 or 4 in. long due to defective cocoons not unwinding evenly. The knobs have to be picked off and the coarse pieces must be removed and pieces of clean thread inserted in their place. To illustrate the pitch of perfection required of the highest grade of silk by users of it, it may be mentioned that seven knobs in a mile and a half of thread is considered far too many and the silk is designated "unclean." As soon as the defects are removed the skeins are divided into four portions by inserting coloured threads between the layers and are then twisted up. The silk is now ready for baling.

Silk is graded for thickness of thread like cotton, but instead of the size being termed "counts" it is measured in "deniers." The French denier weighs $\frac{1}{20}$th part of a gramme. The fineness of silk makes it impossible to gauge the size with the eye, so the standard is a weight. Now a fair average quality of cocoon contains about 440 yards of thread, and this is the standard length taken for weighing for size. A manufacturer asks the Filature to reel for him some bales of 13/15 deniers. By this he means that he wants a thread of which 440 yards measured off will weigh between 13 and 15 deniers. Silk is reeled generally as fine as 9/11 deniers and as coarse as 28/30 deniers—it goes as high as 38/40 deniers for some special purposes. It is the business of the manager of the Filature to know how many cocoon threads combined will make the thickness required. In describing the reeling process, an example of six cocoon threads combined to make one silk thread was taken, but the amount might vary from four to twelve cocoon threads according to the size required. But man proposes, and, in this case, the reeler disposes, so it is necessary, during the reeling, for a reel to be suddenly taken away from a reeler and carried to the silk room for testing. A machine in this room unreels 440 yards of the silk which the reeler has just reeled and this is put on the fine scale and weighed. If 13/15 deniers silk is being reeled and the 440 yards weigh 14 deniers, it is perfect. If it weighs 13 deniers or 15, it is good. If it is 12 or 16 deniers, it is passable. But if it weighs 11 deniers or less, or 17 deniers

or more, it is bad and the reeler has not been attending to her work, i.e. she has not been keeping her eight groups properly supplied with the right number of cocoon threads. She is either careless or incompetent, and if six cocoons was the order she has allowed one or more of her groups to run with four or, perhaps, eight cocoons. So here is another control on the workers which is extremely important from the selling point of view, for manufacturers will not take kindly to a silk that is uneven in its thread, whatever other excellent qualities it may possess.

The establishment of a Filature in Cyprus has had a certain influence on cocoon prices. Perhaps the peasant received about 15 per cent. more than he might otherwise have done during the past crop, but it is to be feared that he expected a sudden Eldorado—something in the region of 100 per cent. more. That, of course, could never be. In what ways, then, can the Filature benefit the industry? It can bring about, by education, an immense improvement in the existing conditions. It can import and distribute the best quality of eggs obtainable and it is in its interest to do so. The better the eggs, the better the cocoons; the better the cocoons, the better the silk. At present, the average weight of cocoons produced from 1 oz. of seed is no more than 60 lb. in Cyprus; in Italy the average is 140 lb. That speaks for itself.

The Filature can also educate in the pruning of the mulberry. There are many trees in Cyprus that are not giving half the quantity of leaf that they should.

Lastly, the Filature is anxious to encourage co-partnership. The peasant is naturally suspicious of a new concern, but if his confidence can be gained, there is no reason why he should not come in and share in the profits. A small beginning has been made in this direction; it may be the grain of mustard seed.

An interesting side-light on this new venture may be mentioned. Hardly before it is out of its cradle the Cyprus Filature has been able to hold out a helping hand to a younger protégé of the Imperial Institute Silk Committee, viz. Sericulture in Iraq. This country is undertaking the revival of what must be to it a very ancient industry, for there is a distinct race of silkworms, now raised in Anatolia,

Persia, Bulgaria and European Turkey, known as the "White Baghdad." A certain number of mulberry trees exist there, and it has been found possible to produce some cocoons, but only on a very small scale.

Everything points to success, and Iraq would like to have a Filature of its own, but it will be some time before this becomes a commercial proposition. It is not possible to erect a reeling plant and wait for the production of cocoons to grow up to meet its requirements. The raw material must first exist, as in Cyprus, and then the establishment of a Filature might be an attractive business.

But the problem (which is not yet a serious one) is, what is Iraq to do with its cocoons in the meantime? Experiments with silk from Iraq cocoons have proved that they are of good quality, but it is necessary to demonstrate its possibilities on a larger scale. The Cyprus Filature has offered to reel the cocoons from Iraq into silk and hand it over to the Committee for experiments in throwing and weaving on a commercial basis. The difficulty of transport from Iraq to Cyprus is practically solved, and it is hoped that all arrangements will soon be completed. So Iraq should soon be out of its present difficulty of disposing of its last crop of cocoons. It may be that the Cyprus Filature will be in a position to continue its support to Iraq until she can carry on alone, but that must depend upon the satisfaction of both parties to the arrangement.

NOTES

Agricultural Industry of Kenya.—The Sixth Annual Report, 1925, on the Agricultural Census of the Colony and Protectorate of Kenya, which has recently been published by the Department of Agriculture at Nairobi, embraces the first complete agricultural census taken since 1922. The census aimed at reviewing the position as existing on June 30, 1925, but, as there appears to be a tendency, partly due to seasonal conditions, to defer sowings, particularly of maize and wheat, to July and early August, it is proposed to alter the date of the agricultural census year to July 31 for the future.

The area under cultivation on June 30, 1925, was 392,628 acres, which represented 8·88 per cent. of the total occupied area. The cultivated area showed an increase of 13·15 per cent. over 1924 and of 67·75 per cent. over 1922.

Information as to changes in the proportion of the cultivated area devoted to principal crops during the four years 1922 to 1925 is summarised in the following table. The figures represent percentages of the total cultivated area on June 30 in the year stated.

Crop.	1922.	1923.	1924.	1925.
Maize	32·2	36·4	40·7	39·7
Coffee	18·5	19·0	17·3	16·6
Sisal	15·9	14·2	13·1	13·4
Wheat	5·9	5·6	6·0	5·4
Coconuts	4·0	3·2	2·6	2·3
Sugar cane	1·6	1·5	1·5	1·7

The percentage area under flax has become quite insignificant, the figure dropping from 4·4 in 1922 to 0·14 in 1925; the relative figure for 1920 was 13·7. The proportion for coconuts also continues to decline and is now only slightly more than one-half of what it was in 1922, the reason being that the area planted has remained more or less stationary, whilst the total cultivated area, as already stated, has increased 67·75 per cent.

Maize is chiefly produced in the districts of Kisumu-Londiani, Nakuru, Trans Nzoia and Uasin Gishu. The proportions of the cultivated area of each district devoted to the production of maize at the date of the census were 37·4, 68·3, 58·5 and 54·3 per cent. respectively, while the relative yields per acre were 8·80, 6·66, 8·79 and 5·98 bags of 200 lb. The total yield of the Colony was 893,108 bags, which was equivalent to 6·89 bags per acre harvested. The total area planted, as at June 30, 1924, was 141,147 acres, but this had increased by 9·4 per cent. to 155,916 acres a year later. In addition it is known that a considerable area was planted subsequently.

The cultivation of coffee now extends to 65,140 acres, but the increase during the census year 1924–25 showed a falling-off as compared with those in earlier years, as witness the following percentage increases at the dates mentioned: June 30, 1922, 28·23; June 30, 1923, 20·50; June 30, 1924, 14·94; and June 30, 1925, 8·47. It is stated that seasonal conditions and apprehension regarding labour supply probably account for the falling-off in the rate of increase. The distribution according to age of trees was: 1–3 years, 26,224 acres; 3–6 years, 17,713 acres; 6 years and over, 21,203 acres. The total production of "clean" coffee was 104,419 cwts. and of coffee

in the parchment (" buni ") 11,111 cwts., thus giving a total of 115,530 cwts. for the colony. An estimate made in June, 1925, of the production for the year 1925–26 was 153,556 cwts., but as unfavourable weather conditions have supervened, this estimate is likely to be considerably modified. The principal producing areas are Kiambu (27,577 acres), Fort Hall (10,081 acres), Kisumu-Londiani (7,831 acres) and Trans Nzoia (6,498 acres).

The increase of acreage under sisal as compared with the previous year amounted to 16·66 per cent., 52,872 acres being planted as at June 30, 1925. The following figures illustrate the progress of the sisal industry during the last five years :

Year.	Area planted at end of year.	Plants of over three years.	Production.	Exports.
	acres.	*acres.*	*cwts.*	*cwts*
1920–21	31,050	15,380	123,820	122,559
1921–22	37,118	19,506	93,540	189,254
1922–23	39,026	22,877	138,420	127,040
1923–24	45,323	27,137	169,094	207,873
1924–25	52,872	35,610	221,820	255,772

Fort Hall (12,916 acres), Kiambu (11,086 acres) and Kitui and Machakos (10,304 acres) are the most important producing districts.

The area planted with wheat at the date of the census was 21,085 acres as compared with 20,910 acres a year previous ; 23,996 acres were harvested, however. Production during the year amounted to 61,067 bags of 200 lb., giving an average yield for the colony of 2·54 bags per acre. Considerable damage by aphides was reported and this undoubtedly affected the yield, particularly in the Uasin Gishu district.

Barley and oats, which may be regarded as secondary grain crops, do not show any change. The area harvested for barley during the year under review was 850 acres, giving a yield of 3·60 bags of 150 lb. per acre.

The increase in the area devoted to cultivation of the coconut was quite small during 1924–25, but, as the areas planted in previous years are now reaching the bearing stage, a substantial increase in production of nuts and copra is recorded. The following figures illustrate the progress made :

Particulars.	Unit.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.
Area planted at end of year .	Acres	10,120	9,378	8,818	8,924	8,971
Nuts produced .	No.	348,091	476,406	557,031	666,617	1,454,996
Copra produced .	Cwts.	789	804	1,340	1,498	3,286

Cultivation of the coconut is confined to the Coast Provinces.

Castor seed appears separately in the returns for the first time, 852 acres having been harvested during 1924–25 and 965 acres being recorded as planted on June 30, 1925. There was, however, considerable variation in the yields notified. Exports of oil seeds and simsim oil from Mombasa were as follows :

Description.	Unit.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25
Castor seed . . .	Cwts.	212	1,005	—	1,413	4,603
Ground nut . . .	Cwts.	3,439	2,298	24,108	37,538	30,663
Linseed . . .	Cwts.	470	4,746	7,240	8,613	5,905
Simsim . . .	Cwts.	27,881	8,959	29,286	87,898	54,161
Simsim oil . . .	Gals.	6,038	3,284	6,779	10,049	10,059

The cultivation of sugar cane continues to increase, the area planted as at June 30, 1925, being 6,556 acres. Of this area 5,044 acres were situated in Kisumu-Londiani. During the year under review 3,680 cwts. of raw and 57,820 cwts. of "crystallised" sugar were produced. The needs of the colony and of the adjacent territories are now being steadily met, as the following returns of imports of sugar into the colony show: 1922, 69,212 cwts.; 1923, 31,652 cwts.; 1924, 27,446 cwts. For the first time exports of sugar appear in the trade returns of Mombasa, 181 cwts. of raw and 739 cwts. of refined sugar being exported during the year 1924–25.

The area harvested for flax has declined from 5,438 acres in 1923–24 to 3,029 acres in 1924–25, and cultivation is now confined to high altitudes. Production of flax was 5,143 cwts., equivalent to 1·70 cwts. per acre; of tow 6,054 cwts., equivalent to 2·00 cwts. per acre; and of linseed 3,642 bags of 180 lb., equivalent to 1·23 bags per acre.

The production of wattle bark was 62,340 cwts., but the area under cultivation dropped from 10,283 acres to 8,830 acres during the year, and there is no evidence of any definite planting programme for the maintenance of the present output of bark.

An interesting development is the inclusion of tea for the first time, an area of 382 acres, lying chiefly in the Limoru and Kericho districts, being recorded on June 30, 1925. During the year 1,341 lb. of tea were produced and marketed locally.

Cotton appears for the first time in the export returns of Mombasa, 1,237 centals valued at £6,038 being exported during the year 1924–25.

Animal products as a whole continue to increase as a result of the continued development of livestock. The following returns show the improvement made:

Particulars.	Unit.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.
Wool-bearing sheep .	No.	98,168	109,748	112,046	135,916	140,725
Wool obtained .	Lb.	176,331	330,781	445,024	427,266	461,586
Exports from Mombasa of:						
Hides . . .	Cwts.	4,087	18,296	28,766	37,233	61,067
Sheep and goat skins . .	Cwts.	3,197	4,333	3,844	5,077	6,795
Other skins . .	No.	7,400	6,589	310	3,864	4,970

The report prepared by the Director of Agriculture concludes: "It could hardly be expected that the rapid rates of increase of recent years could be maintained. Nevertheless there is evidence of steady and substantial progress. The tendency to concentrate effort upon the production of the staple crops, maize, coffee, sisal and wheat is evident. To less important crops little attention is devoted, and in some cases a marked decline is shown. Clearly the Agricultural Industry is getting into its stride and year by year there is less uncertainty about the form which production should take and markets and trade connections for the main products are being improved. The chief factors which operated against greater production and further increased development in 1924–25 were a rather unfavourable season and insufficient labour. Of new capital ready to be put into agricultural development there was said to be a large increase, and in addition the profits which are undoubtedly being made in farming operations go back largely into farm improvements."

Agricultural Developments in Italian Somaliland.—"La Società Agricola Italo-Somala in Somalia" is the title of an article in *L'Agricoltura Coloniale* (1926, **20**, 121) which has been re-issued separately by the Istituto Agricolo Coloniale Italiano of Florence as No. 12 of the *Relazioni e Monografie Agrario-Coloniali* (1926). In this publication Dr. G. Scassellati-Sforzolini gives an account of the activities of the undertaking in question, the "S.A.I.S.," from its foundation in 1920 on the initiative of H.R.H. Prince Luigi of Savoy, Duke of the Abruzzi, to the beginning of the present year, which, it is considered, marks the end of its preliminary stage and the beginning of its definite progress as an economic undertaking and an example of Italian colonial enterprise.

There have been a number of earlier undertakings for exploiting the natural resources of Italian Somaliland, but these for the most part have only met with a small degree of success, either on account of financial difficulties or because of ill-advised choice of locality, or for other reasons. The S.A.I.S. has been started with a definite plan of development and with strong financial backing;

no expense has been spared in carrying out the necessary preliminary engineering and other work and it is considered that its success is assured.

In the first part of the publication an account is given of the nature of the country, the seasonal variations of temperature, rainfall, etc., and of its natural vegetation, as well as of the ethnology of its population. Emphasis is laid on the necessity for understanding the natives and their customs with regard to land tenure, family relationships, religious institutions, etc., in order that the country may be well and peaceably administered.

The climate of Italian Somaliland is very hot and dry. The temperature is highest in March–May, the heat being least intense in July–September. The heat is to some extent mitigated, particularly near the coast, by the monsoons which blow for about eight months of the year. There is little rain, and this falls almost entirely at two seasons, viz. April–May and October–November. The actual amount of rainfall varies considerably from year to year, but the average may be taken as about 400 mm. annually, and the average number of days' rain in the year as about 41.

The natural conditions of the country are thus mainly unfavourable to vegetation other than that of a xerophytic type, but in the southern part the conditions are modified by the presence of two rivers, the Juba and the Webi Shebeli, which have deposited a fertile soil and also supply the means of irrigating it.

The locality chosen by the S.A.I.S. for its undertaking is in the Shidli region, on the river Webi Shebeli. In addition to the possibilities for irrigation, power, etc., afforded by the river, this situation has the advantage of a good supply of labour. The Society has its headquarters at the village of Duca degli Abruzzi and has at its disposition territory on both sides of the river, extending to some 25,000 hectares. The area at present under exploitation is wholly on the left bank of the river and covers about 7,000 hectares. It is divided up into agricultural units of from 600 to 900 hectares, each having its own management, personnel (white and black) and equipment.

An account is given of the preliminary difficulties encountered, the work carried out in clearing and preparing the ground, and the system of irrigation that has been created. Among the numerous industrial and other establishments belonging to the Society the principal ones described include a cotton ginnery and baling press, capable of dealing with 150 to 180 quintals of seed-cotton per 24

hours, and an oil-mill having a capacity of 120 to 150 quintals per 24 hours. The latter is, up to the present, the most important industrial establishment in the Colony. It is capable of dealing with any oil-seed, but is specially equipped for pressing cotton, castor, sesame and kapok seeds. It is hoped that a factory for the manufacture of cane sugar and its by-products will be built in the near future.

The chief crops that are at present being cultivated by the S.A.I.S. are cotton, sugar cane, sesame, castor, millet, dura, kapok, coconuts, and *Vigna sinensis*. The last-named, which is known to the natives as "salboco," is grown on account of its nitrifying action on the soil and for use as a forage plant.

Other crops that are being grown on a small scale include sisal, *Hibiscus cannabinus*, jute, Manila hemp, sunflower, ground nuts, soy beans, niger seed, lucerne, Ceara rubber, tobacco (for local consumption), cassava, sweet potatoes, Jerusalem artichokes, rice, *Eleusine coracana*, *Pennisetum purpureum*, and various fruits and vegetables.

The general principle on which agricultural work is carried out is one involving a kind of co-partnership between the native cultivator and the Society. To each family is allotted a farm, or piece of land suitable for cultivation, of about one hectare in extent, on one half of which food crops are grown and on the other industrial crops. The products of the former belong to the family growing them, whilst those of the latter become the property of the Society. The native thus gives his services in preparing the soil and tending and harvesting the Society's crops, in return for the irrigation of the land, and the provision of a dwelling place, implements for work, medical care, and other advantages.

The most important crop grown in the Colony is cotton, and this is dealt with in some detail by Dr. Scassellati-Sforzolini. The local climatic conditions and the rich alluvial soil are very favourable to cotton cultivation, but on the other hand the pests with which the plant has to contend are a serious difficulty. The best methods of dealing with the various pests, under the conditions prevailing in Italian Somaliland, are being investigated.

More than twenty different varieties of cotton have been tried, but Sakellaridis has always given the best results. This variety has shown itself remarkably well adapted to the local climate and soil, and selected seed of local growth has been sown for several years in succession without any appreciable deterioration in the quality of

the product ; it is recommended, however, that fresh seed should be obtained from Egypt from time to time.

The seed should be sown as soon as possible after ginning. It should first be disinfected, preferably with apparatus of the Simon's hot-air machine type, but where such a machine is not available the seed should be exposed in thin layers to the sun for several days.

For sowing, two seasons are possible, viz. April–June and October–November. The relative advantages of these two periods depend on a number of considerations which are discussed at some length. Experimental work on the subject is being carried out. The question is not yet decided, but the indications appear to be in favour of sowing in the autumn (October–November), whereby greater advantage is taken of the rainy periods and the seasonal variations in temperature, the product being harvested in March or early April.

The amount of irrigation necessary varies according to the season, but as a general rule the least possible quantity of water should be used, since excessive humidity tends to encourage disproportionate vegetative development in the plant. The smaller plants are generally healthier and more productive than those with numerous branches and abundant thick foliage.

When the seedlings are about 15–20 cm. high they should be thinned out, only the best plants being left, and in particular any plants of the Hindi variety should be removed. This variety is easily distinguished from Sakellaridis, even at a very early stage in its growth, by the lighter bluish-green colour of the leaf and by a reddish velvety marking on its upper side near the stalk. The differences become more marked as the Hindi plant develops further. In appearance it resembles the common varieties of American Upland, but the fibre is short, rough and weak, and of little value.

Cotton has been cultivated by the S.A.I.S. since 1922, the average yield in the years 1922–24 being 2·7 quintals of fibre and 5 quintals of seed per hectare. The area planted with cotton in 1925 was 1,500 hectares, and the probable area in 1926 is 1,800 hectares.

The principal insect pests affecting cotton in Italian Somaliland are the pink boll worm (*Gelechia gossypiella*), the red cotton stainer (*Dysdercus* sp.), and a beetle (*Syagrus rugiceps*) which attacks the leaves and roots. The plant also suffers from a disease causing the leaves to shrivel, the flowers and capsules to drop off, and the growth to become stunted and distorted.

White ants attack the cotton plants at some seasons

and in some localities. This pest can to some extent be repelled by the application of common salt round the base of the stem, the earth being removed, and replaced after applying the salt.

The growth of the plant is also adversely affected by the monsoons, from which, however, it can be protected by suitable wind-breaks.

The cultivation of the other crops mentioned above is also dealt with, and some discussion is given of systems of rotation.

Finally there is a summary of the experimental work that has been carried out, since the enterprise was started, in the plant nurseries and experimental plots. This includes trials with economic plants new to the country, trials with different varieties of particular plants, selection experiments, and work on various problems in relation to the special conditions prevailing in the country.

Deterioration of Manila Hemp.—In this BULLETIN (1921, **19**, 127) a report was published giving the results of investigation of samples of Manila hemp which had been found to be deficient in strength. The conclusion reached was that the damage done to the particular consignments from which the samples had been taken was due to a degradation of the cellulose, doubtless due to bacterial action promoted by prolonged storage in a moist condition at a tropical temperature. This view was subsequently corroborated by a study of the causes of the deterioration of the fibre conducted by the Bureau of Agriculture in the Philippines in 1923 (see this BULLETIN 1925, **23**, 223).

A further study of the causes of the deterioration of Manila hemp or " abaca " has since been carried out by P. L. Sherman, Ph.D., and a preliminary report of his work has been published in the issues of the *Cord Age* for February, March, April and May, 1926.

The region of the Philippine Islands chosen for the investigation consisted of the four Bicol provinces, consisting of North and South Camarines, Albay and Sorsogon, lying together in the peninsula at the south-eastern end of the Island of Luzon. These areas were selected for study first, as according to opinion in Manila the greater part of the weak fibre comes from these districts.

There are fifty or more different varieties of the Manila hemp plant in the Bicol provinces, and systematic botanical work is greatly needed to ascertain how many of them are true varieties and to determine their distinguishing characteristics. The four provinces are divided into many producing districts, in each of which both the plants and

fibres have more or less distinctive characters and are known by special names, denoting differences of colour, growth or other features. In all the districts, four or five so-called varieties were found on an average on every hacienda and, of these, one or two were considered to yield weaker fibre than the others and to be more suitable for the production of United Kingdom grades of fibre than of United States grades. Specimens of fibre, known under forty different names, were collected from the principal districts. The nomenclature is very confusing, for the name given to a weak variety in one district was found to be applied to a strong-fibred plant in another.

In addition to the varieties of pure abaca, there are several resulting from hybridisation of abaca with the many varieties of banana growing in the same region. The best known of these are " pacol " and " canton." In the case of pacol the banana characteristics predominate; the fibre is quite distinct from abaca and but little stronger than that of the banana. The canton variety has apparently originated by the further hybridisation of pacol with abaca; this fibre is produced in commercial quantities in certain regions. A study of canton fibres collected in the various districts led Dr. Sherman to the conclusions: (1) that the best variety of canton when mixed with abaca cannot be distinguished or separated from it, whereas hanks of pure abaca and canton are readily distinguishable; (2) that much canton fibre is being sold as abaca and that certain kinds of abaca, possessing canton-like characters, are sold as canton; and (3) that both canton and abaca are good fibres and difficulty is only caused by mixing them.

The cutting of the Manila hemp plant before it has reached maturity results not only in the production of less fibre but also in the production of fibre deficient in tensile strength, firmness and durability. When hacienda owners sell the standing crop, the purchasers, in order to obtain as much fibre as possible, cut everything worth stripping. This practice is very objectionable, for it leads to the marketing of much immature weak fibre which is often mistaken for canton.

The following are regarded as the most important causes of the production of weak and damaged fibre.

The stalks after being cut are sometimes allowed to lie on the wet ground for many days before being stripped and, under these conditions, fermentation and discoloration generally begin to take place within 48 hours.

In some cases the fibrous layers, after having been removed from the stalks, are tied into bundles and left

for from one to four days instead of being stripped at [illegible]e. During the whole of this time the fibres remain soaking in the plant juice, which rapidly ferments and oxidises, thereby staining the fibre yellow or reddish-brown ; the appearance of such stains indicates the ultimate weakening and destruction of the fibre, for, although the fibre may retain its strength for a few weeks, the fermentation is always followed by mould, which completes the damage.

The fibre, after being stripped, must be hung out to dry at once as otherwise fermentation and discoloration ensue.

In addition to all these mistakes which may be made in the preparation of the fibre, there is another danger which is probably the worst of all, namely, the inefficient and incomplete drying of the fibre before packing.

There appears to be little deterioration of the plants due to disease. The experience of those who have reclaimed abandoned haciendas indicates that plants which have once produced good fibre do not become weak-fibred even after years of neglect, and there are many instances in which old, abandoned haciendas have been restored and have become productive sources of good fibre.

As the result of the work so far accomplished, Dr. Sherman has reached the following conclusions.

The Bicol provinces contain many thousands of hectares of good abaca land, bearing plants free from disease, and are capable of producing superior fibre for many years. The present methods of production are antiquated and the hacienda owners are not providing fibre of the quality demanded by modern manufacturing practice, although this could be readily done if the capital invested in the industry were slightly increased. Labour is inadequate and apparently finds it more profitable to produce a large quantity of poor fibre than a smaller quantity of fibre of a better grade. It is anticipated that the use of machinery will do much towards solving the labour problem.

The production of weak fibre is chiefly due to insufficient drying. The United Kingdom grades are more difficult to dry than the United States grades, and so long as no provision is made to ensure satisfactory drying much damaged fibre must inevitably be produced.

Co-operation is needed between the consumer and the producer and the various intervening interests, for unless the producer is aware of the needs of the consumer and is supplied with the knowledge and means to effect desired changes it is impossible for him to produce fibre of the quality required. At the present time the industry is working in the dark.

Empire Forestry Journal.—The first number of Volume V (1926) of the *Empire Forestry Journal* contains much useful and interesting matter. The account of the fourth annual meeting of the Empire Forestry Association includes the speech of H.R.H. the Prince of Wales, K.G., President of the Association, at the Guildhall on March 16, 1926, which was duly reported in the Press. The special articles (several of them illustrated) in the number are well chosen and cover a wide and varied field. Australian forestry conditions are dealt with in accounts of Forestry in Western Australia (S. L. Kessell) and in Victoria (Owen Jones), and in a discussion of Problems of the New South Wales Forestry System (R. Dalrymple-Hay). S. M. Edwards provides "Sidelights on the Maintenance of Forests in Ancient India," and recent publications of the Indian Forest Department are reviewed by A. Rodger, while "Hardwood Problems in Burma" are discussed by W. A. Robertson. The output of Canadian forests in 1924 is dealt with, and a descriptive account of the collection of Cascara bark from *Rhamnus Purshiana* in British Columbia is contributed by E. L. Chicanot. African interest is furnished by articles on the "Exploitation of Forests in Uganda" (R. Fyffe) and on the "East African Pencil Cedar" (H. M. Gardner). Further reference to the last-mentioned article will be found on p. 496 of this issue of the BULLETIN. Other articles include a discussion of the afforestation of certain water catchment areas in this country (J. R. Davidson) and an account of the progress in physiological research at the Forest Research Institute at Zürich (R. Bourne). The editorial notes are numerous and interesting and the reviews and notices of books will be useful to overseas readers.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important, recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

FOODSTUFFS AND FODDERS

Sugar Beet.—Experiments conducted in 1925 at the University Farm, Cambridge, on the growing of beets on subsoiled and unsubsoiled land resulted in favour of the

former, which was ploughed 6 in. deep at the end of January, and subsoiled an additional 3 to 4 in. at the same time. The part unsubsoiled was ploughed 6 in. deep only. The crop was planted early in May and set out and singled at the beginning of June, care being taken that the work proceeded equally on the subsoiled and unsubsoiled parts. At the end of October, the beets from five comparable plots on each part were lifted, topped and washed. The subsoiled plots yielded 13·1 tons of washed roots and the unsubsoiled 12·0 tons. The inference drawn from the experiments is that, at any rate in a dry season and when subsoiling is properly executed, the crop is enabled to obtain more moisture, and consequently to produce a larger crop, and in any case to produce roots which are better shaped and less wasteful in the factory. In addition, advantages are likely to accrue to succeeding crops in the rotation. Experiments on the influence of the date of singling demonstrated that it is desirable to carry out this operation at the earliest possible stage. The utilisation of the tops and the correct method of topping to avoid loss are discussed (*Journ. Min. Agric.*, 1926, **33**, 26).

Citrus Trees.—In *Bull. No.* 62 (1926), *Tech. and Scientific Service, Min. Agric., Egypt*, is a report by Neguib Eff. Iscander, Senior Entomologist, Ministry of Agriculture, on a mission to California (U.S.A.) to study new methods of fumigation of citrus trees for the destruction of scale and other insects. The principal new method is the employment of liquid hydrocyanic acid for fumigation, in place of the " pot " method of generating the gas from cyanide and sulphuric acid. In this method hydrocyanic acid, a colourless liquid, boiling at 80° F., supplied by Californian factories in containers holding 80 lb., is introduced into the tent enclosing the tree. Atomisers may be used which expel the liquid by means of compressed air supplied by a hand pump, or the liquid may be converted into warm gas in a vaporiser by passing it through a coil surrounded by hot water. In California the new method is largely used as it avoids the transport from one place to another of the cumbersome equipment necessitated by the pot method, and eliminates the destruction of tents due to the splashing of sulphuric acid.

The Report states the pot method now in use in Egypt is quite safe and easily carried out by labourers, whereas under local conditions the introduction of liquid hydrocyanic acid, owing to the high temperature during the early months of the fumigation season, the bad roads,

and the additional expenses incurred in storage and handling, which require great care and attention, would prevent any economy as compared with the pot method.

Another method described in the report is the use of dry calcium cyanide. It is blown in the form of a fine dust into the tent enclosing the tree and successfully destroys the insects. The difficulty encountered has been that if used in moist weather or if the application is followed by rain within 24 hours, damage may be caused to the trees. This method is still in the experimental stages.

Johnson Grass.—*Farmers' Bull. No.* 1476 (1926), *U.S. Dept. Agric.*, deals with the utilisation of Johnson grass (*Sorghum halepense*, Pers.) for the production of hay and as pasturage. In the United States south of latitude 38°, it is found on the better soils, particularly those of limestone origin, and has made the production of other crops on these soils very difficult and expensive owing to the labour required to keep them free from the grass. It is a native of the Mediterranean coast countries and was introduced into the United States in 1830, where it is now rather abundant in most of the southern states. Where it already occupies the land, Johnson grass can be profitably utilised as a hay crop, but it has not made a good permanent pasture. Meadows are more productive if ploughed up every third or fourth year. Unless the land is cultivated occasionally, other grasses invade the meadows and reduce the yield to a point where hay production is unprofitable. Much of the hay offered for sale has been of poor quality. Better methods of curing and storing would result in increased profits. In composition and digestibility the hay compares favourably with other grass hays, but it is much less valuable than the legume hays.

OILS AND OIL-SEEDS

Oil-Palm.—Despatches relating to the Sierra Leone Oil-Palm Industry and the establishment of oil-palm plantations have recently been published as *Sessional Paper No.* 12 of 1925, *Colony of Sierra Leone.* These despatches contain a review by the Governor of this Colony of the important conclusions and recommendations made by the Committee appointed by the Secretary of State for the Colonies in September 1925 to consider the best means of securing improved and increased production of palm oil and palm kernels in West Africa (see this BULLETIN, 1925, **23**, 358).

The Governor agrees with the main conclusion of this Committee, "that unless important improvements are promptly introduced there is a grave danger of the palm products industry in British West Africa being seriously affected by the development of plantations equipped with mills in Sumatra and elsewhere," and is of the opinion, therefore, that Sierra Leone must take all possible steps to lessen the cost of production and to improve the quality of the products.

As regards the intensive propaganda recommended by the Committee arrangements have been made for the holding of a conference of the Provincial Commissioners at which will be discussed the best methods for carrying this recommendation into effect.

In connection with the education of the natives as to the advantages of proper management of their palms and the benefits that will accrue by the use of modern machinery for the preparation of the palm products, the Commissioner of Lands and Forests has made the following proposals, which are endorsed by the Governor :—(1) That a suitable palm area, about 2,000 acres in extent, should be selected in each of the three provinces to commence with and that palm stands in such areas should be improved by cutting out unproductive palms and replacing them with good oil-yielding varieties ; by removing the bush and cleaning up the heads of the palms ; by filling up vacant areas with palms of good varieties ; and by eliminating the thick-shelled varieties which yield little pericarp and replacing them with good oil-yielding varieties. (2) That the Government should establish a model plantation, the objects of which would be to prove that an oil-palm plantation is a paying proposition ; to test and prove on a commercial scale the relative values of the different varieties of oil-palms ; and to form an object lesson for the chiefs and natives of Sierra Leone and others who may wish to establish palm plantations. For the purpose of carrying out these proposals a sum of £16,000 is to be provided by the Government.

In putting forward the above suggestions the Governor does not intend to shut out the immediate introduction of private enterprise on the lines recommended by the Committee (provided that the contract system is excluded —a system with which the Governor does not agree, as he is of the opinion that it is unfair to the natives). He thinks, however, that prospective concessionaires would be well advised in their own interests to wait and see how far the proposed experiments succeed.

Experiments have been carried out in Malaya at the Government Experimental Plantation, Serdang, to determine whether the germination of oil-palm seeds could be increased and/or expedited by treating them in any way before being planted (*Malayan Agric. Journ.*, 1926, **14**, 84). In the first trial carried out, 1,000 seeds, obtained from the Tennamaram Estate Batang Berjuntai, were soaked in warm water for seven days prior to being planted in a sand bed. A similar number of untreated seeds were also planted in the same bed. The result of this experiment showed that the treated seeds displayed a slight tendency to give an earlier germination and for more of them to germinate.

In a second experiment seeds procured from young palms growing on the Serdang Plantation were soaked in 1 per cent. hydrochloric acid for seven days and then in water at the ordinary temperature for three days. These treated seeds were sown along with untreated seeds in a sand bed and showed a tendency similar to that displayed by the treated seeds in the previous trial. Other inferences from these experiments are that seeds from young trees germinate much more slowly and have a lower germinating capacity than seeds from older trees. The majority of the seeds from young trees which are capable of germination germinate within seven months of being planted.

Da seed.—The results of the examination of Da seeds (*Hibiscus cannabinus*) are given in the *Bull. Ag. Gén. Col.* (1926, **19**, 530). On extraction with light petroleum the seeds yielded 20·15 per cent. of oil. A small crushing trial showed that on the first pressing at 80° C. under a pressure of 175 kilos. per sq. cm. 11·85 per cent. of oil was obtained, and a subsequent pressing at 95° C. under a pressure of 225 kilos. per sq. cm. furnished a further 1·23 per cent., making a total of 13·08 per cent. The oil gave the following results: acid value 28·69; saponification value 193·2; iodine value 94·14 per cent.; unsaponifiable matter 3·43 per cent. The fatty acids consisted of stearic acid 55·9 per cent., palmitic acid 9·1 per cent., oleic acid 32·6 per cent. and linolic acid 2·4 per cent. Small scale trials indicated that Da oil could be successfully employed for soap-making, the soda soap being suitable for a toilet soap. When refined the oil can be used for edible purposes. The press-cake left after the expression of the oil contained 9·26 per cent. of moisture, 29·18 per cent. of proteins, 9·76 per cent. of oil and 15·66 per cent. of crude

fibre, and resembled in its composition linseed and rape seed cakes. [A sample of Da seed from Northern Nigeria examined at the Imperial Institute in 1920 was found to give similar results.]

Miscellaneous.—Two oil-seeds from Brazil have recently been examined at the Laboratoire National des Matières Grasses, Marseilles, and the results are published in the *Annales du Musée Colonial de Marseille* (1925, 4th ser., Vol. 3, p. 37). " Pracachy " nuts are derived from *Pentaclethra filimentosa* and contain very bitter kernels. These kernels on examination were found to contain 10·6 per cent. of moisture and 48·3 per cent. of oil. Oil was prepared from the kernels by three different methods, namely (1) by expression, (2) by extraction with carbon tetrachloride, and (3) by extraction with carbon bisulphide of the press-cake left after the expression of the oil. Oils 2 and 3 were found to have similar constants, but to differ considerably from the expressed oil, particularly in respect of the melting point and the acid value, and in containing resinous bodies. The expressed oil was pale yellow in colour and possessed a slight, pleasant odour and a slightly bitter taste. It gave the following results on examination: melting point 28° C.; refractive index at 40° C. 1·4561; acid value 3·6; saponification value 182; iodine value 67·3 per cent. and acetyl value 54·2. The oil extracted from the press-cake was of a deep greenish-brown colour and had a cocoa-like odour and a very bitter taste. Its analytical figures were: melting point 40·5° C.; refractive index at 40° C. 1·4562; acid value 60·5; saponification value 176; iodine value 71·8 per cent.; unsaponifiable matter 1·5 per cent.; acetyl value 59; and resinous matter 7·6 per cent. The last-named constituent was found to be removable by extraction of the oil with alcohol. The oil extracted from the press-cake has already been used industrially in Marseilles.

" Jaboty " kernels are oblong in shape and of yellow colour. The botanical identity of the tree from which they are obtained has not been definitely determined. The kernels contained 5·7 per cent. of moisture and 53·7 per cent. of a solid fat, the constants of which were found to be: melting point 45° C.; refractive index at 40° C. 1·4553; acid value 7·0; saponification value 228; iodine value 23·1 per cent.; unsaponifiable matter 1·6 per cent.; Reichert-Meissl value 1·3; and solidifying point of the fatty acids 35·1° C. Palmitic and myristic acids were shown to be present in large proportions in the fatty acids.

ESSENTIAL OILS

Bergamot Oil.—An interesting account of the bergamot oil industry, which is confined exclusively to the Italian province of Calabria, appears in *La Parfumerie Moderne* (1926, **19**, 49). All attempts hitherto made to cultivate this tree (*Citrus Aurantium*) outside this region have proved unsuccessful, although in Calabria it appears to flourish under rather variable conditions as to soil, position and climate. The bergamot is propagated by grafting on wild orange trees three or four years old. Fruiting commences about the sixth or seventh year, with full production in the twelfth year. Every second year the trees are pruned, and each tree is treated with 35 to 70 kilos. of farmyard manure in addition to 3 to 5 kilos. of a mixed chemical fertiliser. About 2,500 hectares (1 hectare = 2·47 acres) are devoted to the cultivation of this product, each hectare containing 400 trees, which under good conditions furnish 150 quintaux (14·76 tons) of fruits. The fruit is harvested from November to February, and the oil extracted by a machine invented in 1850 by N. Barille. In this machine the fruits are pressed between two écuelles, 30 cm. in diameter, the lower being fixed and furnished with points, and the upper one made to rotate and supplied with blades fixed radially. The product of extraction is then forced through woollen bags to remove fine particles of the peel, the oil being afterwards decanted from the water and filtered into copper vessels tinned internally. Although of rather primitive construction no important improvements have been devised in this machine, which leaves an appreciable amount of oil behind in the peel. Each machine deals daily with from about 14 to 16 cwts. of fruits, which yield from about 8 to 9 lb. of oil. From the scrapings of peel remaining in the extraction bags and from immature fruits an inferior oil is obtained by distillation.

The average yield of oil expressed from the fruits is stated to be 0·48 per cent. The normal annual production of bergamot oil is between 150,000 kilos. (147·6 tons) and 200,000 kilos. (196·8 tons).

The principal odorous constituent of bergamot oil is linalyl acetate, which represents 35 to 45 per cent., and occasionally as much as 50 per cent. of the oil.

Bergamot oil is indispensable in the manufacture of many perfumes, especially eau de Cologne.

Medang Losoh (or Lesoh) Oil (*Cinnamomum parthenoxylon*).—The results of the examination at the Imperial

Institute of two samples of Medang Losoh oil from the Federated Malay States were published in this BULLETIN (1925, **23**, 428). According to a report on this oil by B. J. Eaton and G. L. Teik (*Malay Agric. Journ.*, 1926, **14**, 81), the " original sample " examined at the Imperial Institute was obtained from the roots of the tree by a Chinese distiller employing a still and condenser similar to those used in China and Japan for the distillation of camphor wood. The " steam-distilled sample " was obtained by re-distilling the original oil in the laboratory of the Department of Agriculture, Federated Malay States and Straits Settlements, and represented 96 per cent. of the original oil. From a sample of the root of the tree received from the Forest Department, the Department of Agriculture obtained a yield of oil amounting to 3 per cent. of the fresh material.

Production of Essential Oils in the Netherlands and Dutch East Indies.—This subject is dealt with in a special issue of the *Perfumery and Essential Oil Rec.* (1926, **17**, 291). Caraway is the principal essential oil plant cultivated in Holland ; it produces on an average 5,000–6,000 tons of seeds annually, and is the chief commercial source of this product. Being a biennial plant caraway does not produce seed until the second year after sowing, and is therefore sown under cover of other plants, usually the pea. The fruits fall readily from the plants when ripe, and hence special care has to be taken to prevent loss in the harvesting and threshing of the crop. The distillation of the seed is carried out in modern stills of 2,500 kilos. capacity heated to 150° C., the operation being finished in from 6 to 8 hours. If ground up before distillation the seeds furnish a higher yield of oil than when distilled whole. The residue in the latter case, however, has a greater market value, being employed for various domestic purposes, and sometimes for the adulteration of prime seed. The exhausted comminuted seed is of value only as a fodder. The Dutch fruits yield from 3 to 6 per cent. of oil containing from 47 to 55 per cent. of carvone, the value of the oil depending entirely on the amount of carvone present. It is not known to what causes these rather considerable differences in the yields of oil and carvone are due, but it has been proved by cultural experiments that the distance from furrow to furrow has a decided influence.

Java citronella oil is the most important essential oil produced in the Dutch East Indies. This oil has a finer odour and higher value than the Ceylon product, which

contains a much lower percentage of citronellal. Java citronella is stated to be derived from *Cymbopogon winterianus* and is known locally as "sereh wangi." Whereas Ceylon citronella is cultivated on poor soil in a relatively dry climate, the Java plant is grown on rich soil under very humid conditions. The roots are planted 60 cm. apart at the commencement of the rainy season. The age of the plants should not be allowed to exceed 3 to 5 years, for the yield of oil diminishes rapidly as the plants grow older. Citronella is harvested every three months by cutting with a sickle at a height of about 30 cm. from the ground. The average annual yield of citronella is about 30 tons per hectare; the amount of oil per hectare, however, is subject to a good deal of variation. The fresh or dried grass is cut into lengths of about 1 cm. before distillation, for which operation stills of modern design are employed, using steam at a pressure of 2½ to 4 atms. Too heavy a charge in the still must be avoided, as the compression of the soft, heavy mass tends to prevent the steam penetrating evenly throughout. The distillation is carried to the point beyond which any further extraction of oil would prove unprofitable. With a good installation and steam at not more than 3 atms. the whole operation, from the appearance of the first condensed oil and water to the shutting off of the steam, can be carried out in one and a half hours. The yield of oil varies from 0·5 to 1·2 per cent., calculated on the fresh herb.

The citronella oil exported from Java and the neighbouring island of Madura in 1925 amounted to 826,947 kilos.

FIBRES

Cotton

India.—The progress of the Indian cotton industry, with special reference to the efforts of the Imperial and Provincial Departments of Agriculture to effect improvements in the crop, is discussed in the *Review of Agricultural Operations in India*, 1924–25 (Calcutta: Government of India Central Publication Board. 1926).

The area devoted to cotton-growing in that year amounted to 26,465,000 acres as compared with 23,636,000 acres in 1923–24. The yield of cotton was 6,072,000 bales, as against 5,162,000 bales in the previous year, and the average yields per acre in the two years were 92 lb. and 87 lb. respectively. The quantity of raw cotton exported during the year ending March 31, 1925, was 3,326,000 bales of 400 lb. as compared with 3,764,000 bales in the previous year; the consumption of Indian cotton in the

mills of India was estimated at 2,050,891 bales in 1924–25 and 1,798,215 bales in 1923–24.

The Indian Central Cotton Committee has continued to devote attention to the improvement of marketing, the prevention of malpractices, and the general interests of the cotton industry. The Cotton Ginning and Pressing Factories Act, which came into force at the beginning of the 1925–26 cotton season, makes it compulsory for press-owners to mark every bale of cotton with the special mark of the press, the year, and the running number of the bale, and to keep records of the ownership of all cotton pressed; ginning factories have to keep similar records of all cotton ginned. The Act also specifies certain structural requirements for press-houses and ginneries and requires weekly returns to be made of all cotton pressed throughout India with the exception of Burma. The Cotton Transport Act (see this BULLETIN, 1925, **23**, 341) has now been extended to most of the important long-stapled cotton tracts of British India, and similar legislation has been passed by the Baroda and Rajpipla States, thus automatically securing for the zones notified the protection of the British India Act. During the year under review the Committee completed its investigation into the question of the fumigation of American cotton seed to prevent the introduction of the boll weevil; the necessary notification under the Destructive Insects and Pests Act has now been issued by the Government of India, and American cotton is allowed to enter India only at Bombay and then only after proper fumigation.

The Committee have made definite progress with their research schemes. A Spinning Laboratory and Technological Research Laboratory have been established at Matunga and have already been able to be of considerable service to the Agricultural Departments. The Institute of Plant Industry at Indore (see this BULLETIN, 1925, **23**, 342), which is largely financed by the Committee, is now in full working order. Several research schemes undertaken by the Committee have been well advanced; these include researches in the Bombay Presidency on the boll-worm (*Earias* sp.), cotton wilt, the physiology of the cotton plant at Surat, and the improvement of Dharwar-Upland cottons by hybridisation. Progress has also been made with the study of the *G. herbaceum* cottons of Madras Presidency, with an investigation at Cawnpore of the damage caused by the pink boll-worm and the methods of control, and with the improvement of the Oomras cotton and the treatment of wilt disease in the Central Provinces. Several new lines of research are contemplated.

Bombay.—In Sind the cultivation of acclimatised American cotton is extending rapidly in the Jamrao Canal area in spite of the inadequate water supply, and in 1924 an area of 20,000 acres was planted with Punjab-American 4 F and 285 F. On the completion of the Sukkur Barrage canal system the position of cotton growing in Sind will be revolutionised.

In South Gujerat the effort to establish the Surat selection No. 1027 through the whole area south of the Narbada has been continued (cf. this BULLETIN, 1925, **23**, 343), and the cultivation of this cotton is rapidly spreading throughout the Surat District, the southern part of the Broach District and the corresponding portion of the Baroda State ; it is now the only kind grown in the Rajpipla State. An improved hybrid type of cotton has been evolved for the Broach area of Northern Gujerat and is now being introduced for large-scale tests. In the Dholleras area, a good strain of Wagad cotton, the most valuable constituent of the Dholleras cotton, has been developed for general cultivation.

In the southern part of the Bombay presidency, the extension of Dharwar No. 1 and Gadag No. 1 has rapidly taken place, mainly owing to the work of the co-operative cotton sale societies. In the Kumpta cotton area the selected Kumpta types hitherto obtained are of satisfactory staple but low ginning yield. Work is being done on hybrids of Kumpta and *roseum* types and a strain has been isolated which combines the length of the Kumpta cotton with a whiter colour and a better ginning yield. Kumpta cotton types have also been obtained showing a high degree of immunity to wilt disease, which has caused great loss in the Dharwar District.

Madras.—In 1924–25 the area devoted to irrigated Cambodia cotton increased to 248,000 acres and the yield to 142,000 bales, which is the highest yet recorded. The various strains of Cambodia cotton isolated at the Coimbatore Research Station have been further tested, and Cambodia 295 has been issued for large-scale trial in the Avanashi tract near Tiruppur. Another strain, Cambodia 440, is apparently much less susceptible to stem weevil damage than other strains.

The replacement of the ordinary Tinnevelly type by Karunganni has been continued. The area devoted to Hagari 25, the improved type of Westerns cotton, rose from 81,000 acres in 1923–24 to about 180,000 acres in 1924–25. The improved type of Northerns cotton, No. 14, is now being grown on about 20,000 acres.

The Madras Pest Act has been amended and the

improved procedure has ensured smoother working and prompter action in securing the removal of the old crop.

Punjab.—The area devoted to cotton in the Punjab (excluding Native States) in 1925 was estimated at 2,273,000 acres as compared with 1,781,353 acres in 1924. Punjab-American cotton was grown on 934,000 acres and yielded 355,000 bales, or 50 per cent. more than the previous season's crop. Most of this is of the 4 F type, but the 285 F selection, which has a better staple, has made considerable progress in certain tracts. A still later strain, 289 F, is now grown on 2,000 acres. The practice of mixing the native (" desi ") cotton with the new types has caused a disastrous fall in general prices, but it is hoped that the Cotton Ginning and Pressing Factories Act will enable this abuse to be dealt with.

Central Provinces.—Distribution of *roseum* cotton seed has been continued and the Agricultural Department's seed union organisation has been extended. The botanical survey of the cottons of the Province is being advanced and some promising strains have been obtained for testing. The possibilities of the Plateau district for cotton are being investigated and various types have been submitted to trial.

United Provinces.—The new white-flowered cotton, known as Aligarh 19, was sown on 5,000 acres in the 1925 season. The lint is superior to that of the ordinary Aligarh white-flowered variety, but is only suitable for comparatively low counts.

In the Central Circle the cultivation of the J.N. 1 variety is extending ; this cotton has fairly good spinning qualities and a ginning yield somewhat above the average. Several hybrid cottons have been studied and definite strains isolated.

The area devoted to cotton in the United Provinces has decreased from over 1½ million acres in 1913 and 1914 to 1,032,000 and 636,000 acres in 1924 and 1925 respectively and it is therefore necessary to find means of rendering the industry more profitable.

Burma.—Good results have been obtained in Burma in the improvement of the Wagale type by pure line selection and large quantities of seed of a selected strain have been distributed. Satisfactory strains have also been produced by hybridisation of Wagale with Shan cotton of superior staple. Selection work on the Wagyi variety has been continued. The area under Cambodia cotton in the West Central Circle increased during the year from 300 to 600 acres.

Bengal.—A farm has been established in the hill tract

for the study of cottons of the Garo Hill type. Dharwar-American cotton has been successfully grown in Hill Tippera. It is considered that the high lands of Midnapur, Bankura and Birbhum in Western Bengal may prove suitable for cotton-growing and promising results have been obtained with early-maturing strains of Dharwar-American.

Mysore.—Cotton-breeding work has been continued. About 1,500 acres were planted with the pure strain No. 69 of the local ***herbaceum*** cotton, which should yield sufficient seed for planting 10,000 acres. A new variety, Mysore-American IV, a hybrid between the local Dharwar-American and an exotic type, is now regarded as fixed and is being distributed for trial.

Baroda.—The Baroda State Department of Agriculture has continued to co-operate with the Bombay Department, especially in establishing No. 1027 type of Surat throughout the area south of the Narbada (see page 485) and in enforcing the Cotton Transport Act.

Egypt.—The characteristic feature of the system of agriculture practised in Egypt under basin irrigation was the " sharaqi " or summer fallow period. This continued after the development of perennial irrigation and until the year 1898. After that date " sharaqi " ceased to be typical of the cultural practice of Gharbîya and Daqahlîya and at the same time the yield of cotton per acre began to decrease. It has been suggested by McKenzie Taylor and Burns (*Bulletin No.* 25 (1922), *Ministry of Agric., Egypt*) that the decline in yield was directly due to the elimination of the " sharaqi " period. This view has now been confirmed.

In *Bulletin No.* 57 (1926), *Tech. and Sci. Service, Ministry of Agric., Egypt,* entitled " The Effect of the Sharaqi Period upon the Yield of Cotton in Egypt," by E. McKenzie Taylor, D.Sc., a brief summary is given of the work published on this question in earlier Bulletins (Nos. 25, 31, 34 and 52) and the results of further studies are recorded and discussed.

The elimination of the sharaqi period is attributed to the increase of the area devoted to cotton and the early sowing of maize on land not under cotton, so that the land which was formerly subjected to a fallow is now being continuously cropped. It has been found that during the sharaqi period a partial sterilisation of the soil takes place which is of great importance in maintaining the soil's productivity.

The following conclusions are drawn from the more recent experiments. The yield of cotton from land which

has been subjected to a long summer fallow is considerably greater than that from land which has had only a short summer fallow. As the elimination of the sharaqi period is largely due to the early sowing of maize, it is suggested that the date of sowing the maize should be postponed until about August 10, experiments having shown that the extension of the fallow period beyond that date produces little effect on the subsequent cotton crop. The later sowing would cause a slight diminution in the maize crop, but the increased cotton yield would more than compensate for this. Moreover, it would result in a saving of water which could be diverted to the north of the Delta, where it would ensure a successful rice crop and enable further reclamation work to be carried out. The prosperity of the northern part of the Delta would thus be greatly increased.

Argentine Republic.—An interesting account of the progress of the cotton-growing industry in this country has been given by Carlos D. Girola in *Publication No. 49 of the Museo Agricola de la Sociedad Rural Argentina,* entitled "El Cultivo del Algodonero en la Republica Argentina."

The cultivation of cotton was introduced into the Argentine Republic over sixty years ago, but did not undergo any great development until the closing years of the last century. The crop has attracted more attention in recent years and especially since 1917–18. Great advances have been made from 1922–23 onwards owing to the active propaganda that has been carried on and the encouraging results of the enterprise.

The industry, which was at first confined to the Chaco and Corrientes, has now extended to the Provinces of Santiago del Estero, Salta, and Catamarca, and the Territory of Formosa. Its growth has been so rapid in relation to the rural population that some difficulty has been experienced in obtaining the labour required for harvesting, ginning and baling the crop. It is considered that the best results will be obtained if the cultivation develops simultaneously with the growth of the cotton manufacturing industry so that a large part of the produce can be utilised in the country itself and the remainder consigned to foreign markets.

The extension of cotton-growing has been greatly encouraged by the Museo Agricola de la Sociedad Rural Argentina, which has given advice to planters, organised congresses, prepared and disseminated publications on the subject, and carried out investigations of various

kinds. This organisation has thus inspired confidence in the future, and has sustained the industry in difficult times when it would otherwise have been discouraged by falls in the prices of the products, the withdrawal of purchasers, and deficient organisation for ginning and baling and for sale and transport. It has solved many problems which tended to reduce profits or cause losses, and has established factories for ginning and baling.

Considerable work is needed in determining the varieties best adapted to particular zones and classes of land, and for the production of suitable types by selection and hybridisation. The Ministry of Agriculture is actively pursuing investigation in these directions. During the last two years it has employed the services of two specialists in the cultivation and marketing of cotton and has established experimental stations in four different zones. The programme of work includes the trial of new varieties and experiments in seed selection and hybridisation, attention being first directed to the improvement of the "Chaco" variety, which has been acclimatised uninterruptedly for sixty years. This variety has become very mixed, but not to a greater degree than would naturally be expected after so many years of cultivation without any effort being made to maintain its purity.

Argentine cotton is now harvested carefully, the first and second pickings being kept separate from the last pickings, and is ginned in such a way as to avoid breaking the fibres or crushing the seed. The cotton is generally white, of a fairly uniform character and free from stains; it has an average length of about 26–27 mm., a diameter of 0·020–0·022 mm., and is of good strength.

Reference is made in the publication to the Cotton Congresses organised by the Museo Agricola de la Sociedad Rural Argentina in the years 1922–23, 1923–24, and 1924–25.

In the following table particulars are given of the area under cultivation and the quantities of ginned cotton produced and exported during the years 1915–16 to 1925–26.

Year.	Area under cultivation.	Production.	Exports.
	hectares.	*metric tons.*	*metric tons.*
1915–16	4,000	1,000	26
1916–17	5,000	1,000	54
1917–18	8,500	1,500	153
1918–19	10,000	2,500	627
1919–20	12,000	3,000	1,382
1920–21	15,000	3,500	3,012
1921–22	12,000	7,000	2,691
1922–23	22,000	5,000	4,029
1923–24	50,000	8,000	3,452
1924–25	65,000	15,000	5,057
1925–26	85,000	20,000	11,057

[It may be added that a cable received in June, 1926, by the International Institute of Agriculture, Rome, states that the crop for the current year is estimated at 29,220 metric tons of ginned cotton.]

New Zealand Hemp

Natal.—It was stated in the *Times Trade Supplement* of July 31, 1926, that the cultivation of New Zealand hemp (*Phormium tenax*) has been started on the borders of the Newcastle Town Lands in Northern Natal. It is proposed to devote between 2,000 and 3,000 acres to the crop; 5,000 suckers have already been planted, and it is anticipated that planting will continue at the rate of 25,000 suckers per month. The suckers have been imported from the Government plantations at St. Helena and the planting is being supervised by a Government expert from that island.

RESINS

Damar.—In the *Report on Forest Administration in the Federated Malay States for* 1925, it is mentioned that Negri Sembilan is still the only State in which the more valuable damars, e.g. damar penak (*Balanocarpus Heimii*) and damar mata-kuching (*Hopea* spp.), are worked on an organised system. Owing to the attraction of the high wages to be earned on rubber estates efforts to obtain labour for tapping in other States have failed, and the industry in Perak and Pahang, where the possibilities are far greater than in Negri Sembilan, has languished. The production in Negri Sembilan during the year fell to 1,480 pikuls as against 1,710 pikuls for the preceding year. Importation of labour is regarded as the only means of developing the damar penak industry.

Lac.—Since the female lac insect secretes much more lac than the male it will be appreciated that an early determination of the sex ratio would provide a valuable indication of the probable yield of lac to be expected.

According to a paper by S. Mahdihassan on the "Early Recognition of Sex among Lac Insects" (*J. Indian Institute of Science*, **9**A, Pt. I, 1–24), variation in the supply of moisture at the egg stage prior to fertilisation and the nature of the species of lac insect determine the sex ratio, the temperature, and nature of the host having little, if any, effect. With *Lakshadia mysorensis* the moist monsoon period is more favourable to the production of males than females, whilst the dry post-monsoon season produces a preponderance of females. The pre-monsoon crop

gives a generation consisting of males and females in almost equal numbers.

The author gives methods by which the two sexes may be differentiated at an early age, which are summed up in his concluding observations:

"The crawling larva is provided with a shield of wax protecting its skin which with growth shows disarrangement. The male grows flat and long like a cockroach, the female shows height increment, grows like a flea, and ultimately looks like a miniature pear or seed. The full-grown first stage larval cell is made of wax pencils enclosed within a cement of lac. The wax pencils of the hind region show an upward direction of growth in the female and also better development. The full-grown first stage female cell is more raised, the back most of all, and has a broader posterior region with a central raised ridge and two furrows on either side. The male cell of the same age is longer and flatter, broader across the thoracic region and narrower and longer towards its posterior end. The crawling stage, or very young larva of the male, has a flat back, with a more pointed posterior region, and looks like a diagrammatic fish. The female has a central median ridge with its side margins on a lower level and flat."

The paper, which is provided with ten plates, does not lend itself well to abstraction, and the original should be consulted for full details.

Tanning Materials

Australia.—In a pamphlet published by the Technological Museum, Sydney (*Bulletin No.* 10), the authors, M. B. Welch and F. A. Coombes, communicate a paper under the title "The Principal Tanning Materials of Australia and their Leather-forming Properties," containing a review of the position of the chief tanning materials of Australia, namely wattle, pine and mangrove barks, and the eucalypts. Brief botanical descriptions are given together with notes on methods of cultivation, preparation of extracts, tanning value, etc., and the opinions are expressed in the summary that "*par excellence*, wattle bark is the tanning material for the basis of Australian vegetable tannages. Of the acacias, *A. mollissima* and *A. pycnantha* undoubtedly stand pre-eminent, and it is to these that we must look to supply the ever-increasing demand for a general tanning material." "A cheap supply of tan bark is necessary to produce an export leather that can compete in the world's markets." "Mangrove and pine barks could not replace wattle bark in Australian tanneries, but both could be used in varying proportions of a mixed

tannage for the production of sole leather." With regard to the eucalypts, it would appear that sulphited red gum kino should be able to replace sulphited extracts which are now being imported, but further research is necessary.

FORESTRY AND TIMBERS

Aerial Surveying for the Stockmapping of Forest Areas in Burma.—The possibilities of flying as an aid to the stockmapping of forest areas have been further tested in Burma by an aerial survey of the Forests of the Tavoy and Mergui Districts (South Tenasserim Forest Division), a Report on which has been issued as *Burma Forestry Bulletin No.* 13, *Miscellaneous Series, No.* 2, 1926.

An account of the ground survey of portions of these forests has already been published by the Burma Forest Department (this BULLETIN, 1926, **24**, 279), and the present Report is chiefly of interest as dealing with the practical application of aerial surveying to forestry.

There are two possible methods of aerial surveying, viz. (1) aerophotography, and (2) aerial reconnaissance, i.e. sketching and making notes from visual observation.

Each of these methods has advantages and disadvantages as compared with the other. The second is the more dependent on the personal element, skill in rapidly sketching-in necessary forest details and in making brief notes of essential points being an important factor. The photographic method gives accuracy of boundaries ; it shows up some types of forest clearly, particularly those in which a single conspicuous species predominates, but in some cases it does not distinguish well between different forest types. It has the advantage that it can be used in cases where there are no pre-existing maps of the district. Whichever method be employed, the time of year is a matter of importance, as the state of the foliage considerably affects the appearance of the forests from above and the possibility of distinguishing different types.

It should be clearly understood that neither of these methods will replace ground surveying, which is the only means of obtaining information as to species of trees occurring, regeneration, etc., and the different types of forest present. The use of aerial surveying is to enable stockmaps to be made showing the extent of the different forest types after these have already been examined in detail on the ground, and for such purposes as making recommendations regarding areas to be reserved.

Both methods of aerial working were tried in the present survey, but reconnaissance was found to be the most

satisfactory in practice, and was used for almost the whole of the work.

In order to compare the results obtained by the two aerial methods, and by ground surveying, stockmaps of the same district produced by the three methods are included in the Report. These maps exhibit a good agreement in essentials, but show certain differences due to the intrinsic differences of the methods. It is pointed out, however, that the dissimilarities do not generally exceed those that would be found between stockmaps prepared on the ground by different officers.

Descriptions are given in the Report of the appearances from above of the different types of forest ; the most important type is the evergreen, which covers over half the total area. One of the appendixes gives in tabular form the areas of different types of forest in each district, whilst another contains descriptive details of the forest on each map sheet. Proposals are made regarding areas that should be reserved ; and attention is also drawn to the necessity for protecting certain areas against the ravages of shifting cultivation. It is considered that this latter problem may perhaps afford the chief scope for utility of the stockmap.

Forest Resources of Papua and New Guinea.—In a recent issue of this BULLETIN (1926, **24**, 53) reference was made to an article by Mr. C. E. Lane-Poole, Australian Commonwealth Forestry Adviser, on a botanical journey through the forest regions of Papua and New Guinea, which appeared in the *Empire Forestry Journal.*

A detailed official report by Mr. Lane-Poole on his investigations in Papua is now available and it was found convenient to include in this publication an account of his survey of the forests of New Guinea which was carried out on the completion of the work in Papua. The document is issued by the Commonwealth Government under the title of " The Forest Resources of the Territories of Papua and New Guinea " (1925). The previous reference in this BULLETIN quoted above renders it unnecessary to describe again the features of the forests and their composition, but it may be mentioned that the author states that there is no botanical boundary between the two Territories and that the nature of the forests in both is alike. In the report, therefore, the description of the forests in each country is recorded separately, but the technical descriptions of the species occurring in them are given consecutively in one series. Mr. Lane-Poole is no doubt correct in his statements that his work is but the

beginning of the forest survey of the territories and that he has touched only the fringe of a vast field of botanical research. Nevertheless it is clear that his carefully recorded observations have done more than lay the foundations in both spheres of work. The author has confirmed the occurrence of valuable timber trees and forest products in the two countries, but it would appear that in neither has he found areas of forest capable of immediate exploitation. He considers, however, that valuable coniferous forests possibly exist in New Guinea between the Hagen, the Bismarck Range and the Central Range, and mentions that this region is worth thorough exploration. He points out that in both territories the forests, while offering no prospects of immediate profits to large saw-milling operations, possess forest potentialities of a high order. The numerous species and the non-occurrence of pure stands are the main practical difficulties, and in view of the favourable climatic conditions the author is of opinion that there is no reason why forests sufficient to supply a large part of the timber needs of the Australian Commonwealth should not be established. On the smaller islands the possibilities of exploitable forests appeared less than in the case of the main islands, but small areas of profitable forest of *Eucalyptus Naudiniana* (yielding for many years past the best general building timber for Rabaul) are still to be found. The report is well illustrated and indexed, and is accompanied by a number of large, useful maps.

Exploitation of Malayan Forests.—It has been realised for several years that the forest resources of Malaya have been wasted owing to the uneconomical methods of extraction, conversion and utilisation. This has been due to the fact that three or four species only have been acceptable to timber users, namely, those that have been known for their durability, strength and ease of conversion; other species that require more careful seasoning and whose properties are not so well known have been neglected. A shortage of the "popular" hardwood timbers is threatened, and the necessity for research on the seasoning and preservation of the inferior species so that substitutes may be found is now realised.

In 1920, the Conservator of Forests and the Deputy Locomotive Superintendent of the Federated Malay States carried out an "investigation in Great Britain into the possibility of improving the methods of conversion and of increasing the durability of inferior quality timbers by artificial means." Their report was referred

to a committee appointed by the Government of the Federated Malay States in 1922. The committee sought the advice of the President of the Forest Research Institute, Dehra Dun, and on receipt of his reply reported to the Government that in conjunction with the large saw mill, which it was proposed to erect, an impregnation and seasoning plant and a timber testing plant should be installed as soon as possible. They proposed that Mr. H. P. M. Kent, Controller of Timber Supplies, F.M.S., should visit India to study the methods employed at Dehra Dun and at such other places as he thought fit, to enable him to put forward recommendations together with detailed estimates of costs.

Mr. Kent's report on the "Equipment necessary for: A.—Experimental Research on the Properties of Malayan Timbers; B.—Economic Exploitation of a Malayan Forest Reserve," is published in the *Proceedings of the Federal Council of the Federated Malay States for the year* 1925. His report is divided into two parts, the first containing recommendations as to the type of plant necessary, with preliminary specifications and estimates for the storage and conversion of logs and the subsequent processes of seasoning, wood preservation and timber testing, and to a minor extent for the extraction and transport of logs.

The second part is devoted to a description of the equipment and methods followed at Dehra Dun and its affiliated organisation at Rangoon; other information germane to the subject obtained elsewhere is also included.

Malayan Timbers.—Heavy and increasing demands for timber, especially in the mining districts, and a scarcity of labour for cutting the required supplies owing to the attractions offered by employment on rubber estates, are recorded in the *Report on Forest Administration in the Federated Malay States for the year* 1925. Nevertheless, the total outturn of timber rose from 159,258 tons in 1924 to 169,647 tons in 1925, firewood and charcoal also increasing from 630,154 tons to 674,958 tons. A number of interesting projects have arisen out of the recommendations of the Wood Industries Committee. A special seasoning test of keruing (*Dipterocarpus* spp.) is in progress: experiments carried out by an oil-palm company, with official assistance, to investigate the possibility of using local timbers for making "tight" barrels have indicated the suitability of nyatoh (*Palaquium* and *Payena* spp.) and mersawa (*Anisoptera* sp.) timbers for this pur-

pose: in furniture making, special success was obtained in the use of sepetir (*Sindora* spp.) for ornamental work, and pengarawan penak (a form of merawan, *Hopea* spp.) proved satisfactory for certain types of furniture and for joinery; other woods used were buey (*Diospyros* sp.), nyireh (*Xylocarpus* = *Carapa* sp.), betis (*Payena utilis*) and sepam (*Mangifera* sp.).

East African Pencil Cedars.—A useful account of the East African pencil cedar tree and of the timber yielded by it is contributed to the *Empire Forestry Journal* (1926, Vol. V, No. 1) by H. M. Gardner, of the Forest Department, Kenya Colony. The tree concerned (*Juniperus procera*) is the largest juniper known and is stated to be the commonest timber tree in Kenya. The principal home of the species is Kenya Colony, but the distribution extends into the northern part of Tanganyika Territory and into Abyssinia. It is estimated that in Kenya the exploitable cedar forests total some 325,000 acres, these forests varying from practically pure stands down to mixed forest where the cedar does not amount to more than 15 per cent. of the crop. As is well known, the timber closely resembles in appearance and qualities the true American pencil cedar (*Juniperus virginiana* and *J. bermudiana*), supplies of which are very scarce; the East African wood is the only genuine pencil cedar in the world of which any considerable stocks remain. Several trials of the timber for pencil-making have been made by manufacturers, but progress in its use for this purpose has hitherto been slow. The author considers this to be due to the conservatism of the manufacturers, the failure to supply the timber in proper condition as regards seasoning, sawing and selection of grain, and to the absence of exact information as to the quantities available. It should not be impossible to overcome these difficulties and to find a recognised place for the timber as a pencil wood. The excellent qualities of the timber also suggest its use for cabinet and other purposes. The well-known heartrot which affects the living tree as a result of attacks by the fungus *Fomes juniperinus* is discussed, and the author concludes that by growing the cedar in suitable localities under proper sylvicultural management perfectly sound timber can be produced.

In this connection developments in regard to this cedar in Tanganyika are of interest. The *Fourth Annual Report of the Forest Department of Tanganyika Territory* (1924) states that the Tanganyika Forest and Lumber Co.,

Ltd., has manufactured pencil slats for export and that some 416,000 slats were sent overseas during the year to London, New York, Copenhagen and Germany. The same report also refers to the experimental planting of *Juniperus procera* being carried out by the Department.

Greenheart.—A useful summary of information regarding Greenheart (*Nectandra Rodiœi*) has been prepared by the Forestry Department of British Guiana and published as a Forestry Notice in the *Official Gazette* of the Colony for July 17, 1926. The notice states that true greenheart is found in commercial quantities only in the north central portion of British Guiana, behind the coast lands and principally in the area drained by the Cuyuni, Mazaruni, Essequibo, Demerara and Berbice rivers. The area of forest over which greenheart is known to occur is roughly 20,000 square miles, while calculations based on recent strip valuation surveys indicate that a certain named area of some 2,360 square miles contains above 300,000,000 cubic feet of sound, merchantable greenheart. The notice gives an account of the characters and technical qualities of the timber, and includes extracts from the report of the Committee of the Institution of Civil Engineers on the Deterioration of Structures in Sea Water, and from other sources, concerning experience gained with the timber when used in the construction of dock gates. The varying immunity of the timber to different species of teredo, and the influence of brackish and salt water on the question, are discussed. Purchasers of greenheart are advised to stipulate that the timber bought by them shall have received the official certificate of the British Guiana Forestry Department that the timber is true to type and free from serious defect at the time of shipment.

Timbers in Netherlands Indies.—A publication issued by the Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië as *Mededeelingen van het Proefstation voor Thee, No. XCVII* (1926), and entitled "Houtsoorten der Cultuurgebieden van Java en Sumatra's Oostkust," gives particulars of the properties, uses and anatomical characteristics of a large number of timbers occurring in Java and Eastern Sumatra, together with their botanical and vernacular names. It is accompanied by a *Platenatlas* containing 124 photo-micrographs of woods. A useful feature is a table for the determination of woods whose identity is unknown.

It would seem that this publication covers some of the

ground to be traversed by the series entitled "Belangrijke Houtsoorten van Nederlandsch-Indië," of which the first part has already appeared (see this BULLETIN, 1926, **24**, 280).

Timbers in Dutch Guiana.—The Koninklijke Vereeniging Koloniaal Instituut of Amsterdam have issued as *Mededeeling No. XXII, Afdeeling Handelsmuseum, No.* 6, a publication entitled "De Houtsoorten van Suriname," Deel 1. Its chief object is to enable persons having limited scientific knowledge to identify different woods, principally from such characteristics as can be determined without further apparatus than a pocket-knife and a hand-lens.

A number of woods are described, and a separate "Atlas" contains photographs showing the appearances of different woods under low magnification.

Timber Seasoning in the Tropics.—The non-success which has so often attended efforts to establish an export trade in secondary timbers from tropical colonies, or even to use the timbers locally in competition with imported woods, has usually in part resulted from the lack of attention to the seasoning of the timbers concerned. A most useful paper on the seasoning of timber, read before the Agricultural Society of Trinidad and Tobago by Mr. R. C. Marshall, Conservator of Forests, appears in the April issue of the *Journal* of the society (1926, **26**, 197). In order to produce well-conditioned timber it is necessary to have a sound knowledge of the main difficulties encountered in seasoning the material, and Mr. Marshall referred in some detail to the questions of varying moisture content and distribution, case hardening, warp and split, and insect and fungal diseases. He then indicated the results which had been obtained from experiments conducted by his department with the object of investigating the behaviour of certain Trinidad woods while seasoning in an open timber shed. Over 73,000 board feet of a considerable number of species were handled, the timber being sawn and stacked mostly within two or three days of felling. The stacks were carefully piled (using uniform "stickers") and arranged so that the prevailing winds passed through the stack. It was found that, generally speaking, six months were sufficient to season 1 in. boards and it is expected that further experience will indicate that shorter periods are satisfactory. Observation of shrinkage gave interesting results of much practical value. Mr. Marshall mentions that in spite of the handicap of

sawing plant which resulted in much unnecessary wastage, it was found possible to market the bulk of the sawn lumber at a price which enabled it to compete with imported lumber.

A further instance of the importance of seasoning is afforded by the case of the Malayan dipterocarp timber, keruing. The *Report on Forest Administration in the Federated Malay States for* 1925, quoting a report by Mr. Kent, states that " the economic utilisation of the timbers of the Malayan forest hinges very largely on the economic use of keruing," which timber has been condemned in certain quarters on account of its tendency to split. This defect, however, may be due to imperfect methods of seasoning, and a large-scale experiment in the air-seasoning of the timber is in progress under the auspices of the Wood Industries Committee.

The Silver Fir Chermes.—In recent years a considerable amount of damage has been done to young plantations of silver fir in this country by Chermes (*Dreyfusia*). A study has been made of this insect and its relationship to its host tree in Britain, and, in addition, information on the subject has been collected in Denmark under the auspices of the Department of Scientific and Industrial Research, and the results have been published by the Forestry Commission as *Bulletin No.* 7, 1926.

The genus *Dreyfusia* has been divided into two species, *D. nüsslini* and *D. piceæ*, both of which occur on silver fir, but there is some doubt as to whether the two are not simply racial forms of one species. However this may be, the first of the two, which is the more harmful, is found on the young twigs of the tree, whilst the latter concentrates upon the older stems and branches and, in the case of young trees, upon the buds and branch nodes.

The life history of the insect is interesting, the full cycle consisting, in the case of *D. nüsslini*, of five generations covering a period of two years, and including two host trees, viz. the silver fir and the oriental spruce, though in Britain the cycle is generally reduced to two wingless generations alternating between the needles and bark of the young shoots and branches of the silver fir.

Some details are given in the *Bulletin* of the distribution in Britain of the three principal species of silver fir grown in this country, viz. *Abies pectinata* (the European silver fir), *A. grandis* (giant fir), and *A. nobilis* (noble fir), and of the occurrence of Chermes. The first of these

three species is the most subject to attack, though other two cannot be regarded as immune.

An account follows of the cultivation of *A. pectinata* in Denmark, where this species forms about 90 per cent. of the silver fir stand, and of the incidence of Chermes in that country. The causes underlying the prevalence of the pest in some districts rather than others are not yet clearly known, but it would appear that soil and climate are determining factors as well as the choice of seed for the particular locality. Regular thinning has been found to do much towards lessening the attacks of the insect, probably owing to the beneficial effect of light on the tree and its unfavourable effect on the development of the insect.

By way of artificial control measures, good results have been achieved by spraying with a 3–5 per cent. solution of lysol.

The application to conditions in Britain of the experience gained in Denmark is discussed, and stress is laid on the importance, in establishing future plantations, of producing clean nursery stock. It is suggested that the only reliable way of raising such stock is to grow it from seed in a place isolated from other silver fir. Infection can occur over small distances, the insects being conveyed presumably by wind or animals, but it is unlikely that the pest would spread over large distances in this country since the winged forms only rarely occur, and even if they were produced, they would probably die in the absence of their proper host, the oriental spruce, which is relatively uncommon.

Insect Pests of Timber in New Zealand.—*Bulletin No. 2, New Zealand Forestry Service,* 1925, entitled "Forest and Timber Insects in New Zealand," gives a preliminary account of the insects found in the forests of New Zealand and their depredations. Their natural and artificial control is discussed, and a number of photographs are included showing various insects and their method of attack.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc, contained in publications received in the Library of the Imperial Institute during the three months, June-August 1926

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S W 1 *Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London*

AGRICULTURE

General

Review of Agricultural Operations in India 1924–25 Pp 162, 10 × 6¾ (Calcutta Government of India Central Publication Branch, 1926) Price Rs 2, As 2 (4*s*)

Proceedings of the Board of Agriculture in India, held at Pusa on December 7, 1925 and following days with Appendices Pp 154, 10 × 7 (Calcutta Government of India Central Publication Branch, 1926) Price Rs 1 As 14 (3*s* 3*d*)

Annual Report of the Department of Agriculture, Bengal, for the Year 1924–25 Pp 24 + ccxlviii, 9½ × 6¼ (Calcutta Bengal Secretariat Book Depot 1925) Price Rs 5 or 8*s* 6*d*

Annual Report of the Department of Agriculture, Bombay Presidency, for the Year 1924–25 Pp 109, 9½ × 6 (Bombay Government Central Press, 1926) Price Rs 2, As 2, or 4*s*

Report on the Operations of the Department of Agriculture, Punjab, for the Year ending June 30, 1925 Part I Pp 52 + ciii, 9½ × 6¼ (Lahore Superintendent, Government Printing, 1926) Price Rs 3, As 8, or 4*s* 8*d*

Report on the Administration of the Department of Agriculture, United Provinces, for the Year ending June 30, 1925 Pp 61, 9¾ × 6½ (Allahabad Superintendent, Government Press, 1925) Price Rs 1, As 11

Annual Report of the Department of Agriculture Seychelles, for the Year 1925 Pp 8, 13 × 8¼. (Victoria, Mahe Government Printer, 1926)

Annual Report on the Agricultural Department, Nigeria, for the Year 1925 Pp 15, 13 × 8¼ (Lagos Government Printer, 1926)

Annual Report of the Lands and Forests Department, Sierra Leone, for the Year 1925 Pp 45, 13 × 8¼. (Freetown Government Printing Office, 1926)

Report of the Department of Agriculture, Union of South Africa, for the Year ended June 30, 1925 *Ann Dept Repts*, No 5, pp 108–262 (Pretoria Government Printing Office, 1926) Price 5*s*

Report on the Agricultural Department, Grenada, 1925 Pp 12, 13 × 8¼ (Trinidad Imperial Commissioner of Agriculture for the West Indies, 1926) Price 6*d*

Annual Report of the Department of Agriculture, Jamaica, for the Year ended December 31, 1925. Pp 23, 13 × 8¼ (Kingston: Government Printing Office, 1926)

Administration Report of the Director of Agriculture, Trinidad and Tobago, for the Year 1925. *Council Paper No* 60 *of* 1926 Pp. 36, 13 × 8¼. (Trinidad Government Printer, 1926) Price 1s. 3*d*

Agricultural Survey of Europe: Germany. By L. G. Michael. *Dept. Bull. No.* 1399, *U.S. Dept. Agric.* Pp. 112, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

Notes on Agriculture in Japan gathered during a voyage in 1924. By P. J. S. Cramer. *Communic. No.* 22, *Gen. Exper. Sta. for Agric., Dept. Agric., Ned. E. Ind.* Pp. 56, 10½ × 7¼. (Weltevreden: Landsdrukkerij, 1926.) Price fl.1.25.

Work and Expenditures of the Agricultural Experiment Stations, 1924. *U.S. Dept. Agric.* Pp. 114, 9¼ × 6. (Washington: Government Printing Office, 1926.)

Report of the Alaska Agricultural Experiment Stations, 1924. Pp. 47, 9¼ × 6. (Washington: Government Printing Office, 1926.)

Report of the Guam Agricultural Experiment Station, 1924. Pp. 14, 9¼ × 6. (Washington: Government Printing Office, 1926.)

Report of the Virgin Islands Agricultural Experiment Station, 1925. Pp. 17, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Agricultural Survey of South America, Argentina and Paraguay. By L. M. Estabrook. *Dept. Bull. No.* 1409, *U.S. Dept. Agric.* Pp. 90, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

Electroculture. By L. J. Briggs, A. B. Campbell, R. H. Heald, and L. H. Flint. *Dept. Bull. No.* 1379, *U.S. Dept. Agric.* Pp. 34, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

The Soil

The Soils of the Amazon Basin in Relation to Agricultural Possibilities. By C. F. Marbut and C. B. Manifold. *Geogr. Rev.* (1926, **16**, 414–442).

The Reclamation and Settlement of Land in the United States. By F. L. Tomlinson. *Int. Rev. Agric. Econ.*, N.S. (1926, **4**, 225–272).

A Study of the Value of Crop Rotation in Relation to Soil Productivity. By W. W. Weir. *Dept. Bull. No.* 1377, *U.S. Dept. Agric.* Pp. 66, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Soil Productivity as Affected by Crop Rotation. By W. W. Weir. *Farmers' Bull. No.* 1475, *U.S. Dept. Agric.* Pp. 22, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Soil Fertility. Its Maintenance and Improvement by Means of Green Manure and Cover Crops (*cont.*). By H. Wenholz. *Agric. Gaz., N.S.W.* (1926, **37**, 374–376).

The Decomposition of Green and Organic Manures under Tropical Conditions. By A. W. R. Joachim. *Trop. Agric., Ceylon* (1926, **66**, 308–312).

Malayan Guano Deposits. By V. R. Greenstreet. *Mal. Agric. Journ.* (1926, **14**, 106–115).

Nature and Availability of the Plant-Food Constituents of Philippine Guano. By M. Tirona. *Phil. Journ. Sci.* (1926, **30**, 69–78).

A Preliminary Investigation on the Absorption of Fertilisers by Ceylon Soils. By A. W. R. Joachim. *Bull. No.* 75, *Dept. Agric., Ceylon.* Pp. 19, 8½ × 5½. (Colombo: Government Printer, 1926.)

Insect Pests—General

Insects: Their Relation to Man and their Control. By F. Q. Otanes. *Philippine Agric. Rev.* (1925, **18**, 373–410).

Report on the Work of the Entomological Section, Ministry of Agriculture, Egypt, from its Commencement in August 1911 to

March 1923. Pp. 106, 10½ × 7¼. (Cairo: Government Press, 1926.) Price P.T.10.

The Philippine Plant Quarantine Service. By G. Merino, N. G. Teodoro and F. Q. Otanes. *Philippine Agric. Rev.* (1925, **18**, 411–461).

The Plant Pest and Disease Control Service of the Philippine Bureau of Agriculture. By N. G. Teodoro. *Philippine Agric. Rev.* (1925, **18**, 463–549).

The Use of the Aeroplane for Applying Insecticides. By A. D. Imms. *Journ. Min. Agric.* (1926, **33**, 205–210).

Fumigation with Hydrocyanic Acid Gas. Concentration and Distribution as Influenced by Fumigation Procedure. By B. J. Smit and T. J. Naude. *Sci. Bull. No.* 48, *Dept. Agric., Un. S. Afr.* (*Div. of Chem. Ser. No.* 66.) Pp. 23, 9½ × 6. (Pretoria: Government Printing Office, 1926.) Price 3*d.*

The Japanese Beetle (*Popillia japonica*, Newm.). By L. B. Smith and C. H. Hadley. *Dept. Circ.* 363, *U.S. Dept. Agric.* Pp. 66, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 25 cents.

Notes on the Stem Eelworm. By W. E. H. Hodson. *Journ. Min. Agric.* (1926, **33**, 259–262).

Preventing Damage by Termites or White Ants. By T. E. Snyder. *Farmers' Bull. No.* 1472, *U.S. Dept. Agric.* Pp. 22, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Plant Diseases—General

Phytopathology: Its Fundamental Principles. By N. G. Teodoro. *Philippine Agric. Rev.* (1925, **18**, 325–371).

Preliminary List of Plant Diseases Recorded in Southern Rhodesia. By F. Eyles. *Rhod. Agric. Journ.* (1926, **23**, 629–651).

Check List of Diseases of Economic Plants in the United States. By P. J. Anderson and others. *Dept. Bull. No.* 1366, *U.S. Dept. Agric.* Pp. 111, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Interspecific Transmission of Mosaic Diseases of Plants. By K. H. Fernow. *Mem.* 96, *Cornell Agric. Exper. Sta.* Pp. 34, 9¼ × 6. (Ithaca, N.Y.: Cornell University, 1925.)

Foodstuffs—General

Report of the Food Investigation Board, Department of Scientific and Industrial Research, for the Year 1924. Pp. 80, 9½ × 6. (London: H.M. Stationery Office, 1925.) Price 3*s.* 6*d.*

The Chemical Composition of the Food Grains, Vegetables and Fruits of Western India. By D. L. Sahasrabuddhe. *Bull. No.* 124 *of* 1925, *Dept. Agric., Bombay.* Pp. 38, 9¾ × 6¼. (Bombay: Superintendent, Government Printing, 1925.) Price Ans.3–6, or 4*d.*

Beverages

Unpruned Tea. By H. R. Cooper. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part I, pp. 1–12).

Aluminium als verpakkingsmaterial voor Thee [in Dutch and English]. By J. J. B. Deuss. *Med. Proefsta. voor Thee, No. XVCI.* Pp. 21, 10½ × 7¼. (Batavia: Drukkerijen Ruygrok & Co., 1926.) Price fl. 2.

Preliminary Report on the Application of Calcium Cyanide Dust to the Control of Helopeltis in Tea. By W. H. Brittain and W. S. Shaw. *Planters' Chron.* (1926, **21**, 527–531).

Calcium Cyanide and its Utilisation in the Control of Insect Pests in Ceylon. By W. H. Brittain. *Trop. Agric., Ceylon* (1926, **67**, 45–49).

Branch Canker of Tea. By C. H. Gadd. *Trop. Agric., Ceylon* (1926, **66**, 272–276).

Quarter-Century of Kenya Coffee. By J. Franklin. *Tea and Coffee Tr. Journ.* (1926, **50**, 703–705).

Over Koffiezaad. By A. J. Ultée. *Arch. voor de Koffiecultuur* (1926, **1**, 181–193).

Nieuwe Methoden voor de Ontsmetting van Koffiezaad. By H. Begemann. *Arch. voor de Koffiecultuur* (1926, **1**, 208–216).

A Industria da Herva Mate em Matto Grosso. By J. J. Aguiar. *Bol. Min. Agric., Indust. e Comm., Rio de Janeiro* (1926, May, No. 5, pp. 679–689).

Cereals

Cereal Growing in Alaska. By C. C. Georgeson and G. W. Gasser. *Bull. No.* 6, *Alaska Agric. Exper. Sta.* Pp. 40, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Blé et Orge de Mauritanie. By H. Jumelle. *Ann. Mus. Col. Marseille* (33e Ann., 4e sér., 3e vol., 1925, 3e fasc., pp. 5–11).

Cleaning Grain with the Bates Aspirator. By E. N. Bates, H. P. Bodnar and R. L. Baldwin. *Misc. Circ. No.* 56, *U.S. Dept. Agric.* Pp. 21, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Control of Insect Pests in Stored Grain. By E. A. Back and R. T. Cotton. *Farmers' Bull.* 1483, *U.S. Dept. Agric.* Pp. 30, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

The Granary Weevil. By E. A. Back and R. T. Cotton. *Dept. Bull. No.* 1393, *U.S. Dept. Agric.* Pp. 35, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Control of Smuts of Wheat and Oats with Special Reference to Dust Treatments. By R. C. Thomas. *Bull.* 390, *Ohio Agric. Exper. Sta.* Pp. 19, 9¼ × 6. (Wooster, Ohio, 1925.)

A Comparison of Maize Breeding Methods. By G. N. Collins. *Dept. Bull. No.* 1396, *U.S. Dept. Agric.* Pp. 21, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Maize for Export. By S. D. Timson. *Rhod. Agric. Journ.* (1926, **23**, 613–625).

Leaf Blight of Corn. By S. L. Marquez. *Circ. No.* 173, *Bur. Agric., Manila, Phil. Agric. Rev.* (1925, **18**, 571–572).

Possibilities of Increasing the Fields of Paddy in Ceylon by the Use of Pure Line Selected Seed. By G. V. Wickramasekera. *Trop. Agric., Ceylon* (1926, **66**, 223–231).

Rice Cutworms. By F. Q. Otanes. *Circ. No.* 83 (*Rev.*), *Bur. Agric., Manila, Phil. Agric. Rev.* (1925, **18**, 551–554).

Tillage in Relation to Milling and Baking Qualities of Wheat. By M. C. Sewell and C. O. Swanson. *Tech. Bull.* 19, *Kansas Agric. Exper. Sta.* Pp. 16, 9¼ × 6. (Manhattan, Kansas, 1926.)

Segregation and Correlated Inheritance in Marquis and Hard Federation Crosses, with Factors for Yield and Quality of Spring Wheat in Montana. By J. A. Clark and J. R. Hooker. *Dept. Bull. No.* 1403, *U.S. Dept. Agric.* Pp. 70, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Sugar

A Study of the Sugar-Beet Position. By A. Bridges and R. N. Dixey. *Journ. Roy. Agric. Soc., England* (1925, **86**, 59–89).

Sugar Beets in Wisconsin. By A. H. Wright. *Circ.* 195, *Wisconsin Coll. Agric. Extension Serv.* Pp. 15, 9¼ × 6. (Madison: University of Wisconsin, 1926.)

The Utilisation of Sugar Beet By-Products. By H. E. Woodman. *Journ. Min. Agric.* (1926, **33**, 109–117).

Fiji Disease of Sugar Cane. By S. L. Marquez. *Circ. No* 174, *Bur. Agric., Manila, Phil. Agric. Rev.* (1925, **18**, 573–574).

Mosaic Disease of Sugar Cane in India in 1925. By W. McRae. *Agric. Journ. India* (1926, **21**, 198–202).

Rare Cases of Mosaic Disease in Highly Resistant Varieties of Sugar Cane. By P. A. Voder. *Dept. Circ.* 392, *U.S. Dept. Agric.* Pp. 7, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Root Disease of Sugar Cane in Louisiana. By R. D. Rands. *Dept. Circ.* 366, *U.S. Dept. Agric.* Pp. 19, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Root Crops

Hot Formaldehyde for Potato Seed Treatment. By R. E. Vaughan and J. W. Brann. *Circ.* 202, *Extension Serv., Coll. of Agric., Wisconsin.* Pp. 8, 9¼ × 6. (Madison, Wisconsin, 1926.)

The Potato Froghopper and How to Control it. By J. E. Dudley, Jr. *Farmers' Bull. No.* 1462. Pp. 12, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

The Potato Tuber Worm. By H. Spencer and W. O. Strong. *Bull.* 53, *Virginia Truck Exper. Sta.* Pp. 45, 9¼ × 6. (Norfolk, Virginia, 1925.)

Potato Wilt and its Control. By M. B. McKay. *Bull.* 221, *Oregon Exper. Sta.* Pp. 23, 9¼ × 6. (Corvallis, Oregon, 1926.)

Fruits

Report of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs Produced in the Overseas Parts of the Empire. Third Report—Fruit. Pp. 274, 9¼ × 6. (London: H.M. Stationery Office, 1926, Cmd. 2658.) Price 4*s.* 6*d.*

Cold Storage Investigations, Season 1925. *Chem. Dept. Bull. No* 1, *New Ser., Cawthron Inst., Nelson, N.Z.* Pp. 16, 9¾ × 6¼. (Nelson: R. W. Stiles & Co., 1926.)

Marketing Western Boxed Apples. By G. B. Fiske and R. R. Pailthorp. *Dept. Bull. No.* 1415, *U.S. Dept. Agric.* Pp. 95, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

Marketing Barreled Apples. By G. B. Fiske. *Dept. Bull. No.* 1416, *U.S. Dept. Agric.* Pp. 99, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

The Apple Fruit Miner and the Apple Fruit Fly. *Journ. Min. Agric.* (1926, **33**, 339–342).

Apple Blotch. By J. W. Roberts and L. Pierce. *Farmers' Bull. No.* 1479, *U.S. Dept. Agric.* Pp. 11, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Pseudococcus comstocki, Kuw, as an Enemy of the Banana (*Musa Cavendishii*). By R. Stewart MacDougall. *Bull. Entom. Res.* (1926, **17**, 85–90).

Banana Diseases in the Philippines. By F. B. Serrano. *Circ. No.* 176, *Bur. Agric. Manila, Phil. Agric Rev.* (1925, **18**, 578–582).

A Bacterial Wilt Disease of Bananas in Trinidad caused by *B. Solanacearum*, E. F. Sm. By S. F. Ashby. *Trop. Agric., W. Ind.* (1926, **3**, 127–129).

"Bunchy Top" in Bananas. Final Report of Investigation Committee. *Queensland Agric. Journ.* (1926, **25**, 506–510).

Notes and Observations on the Red Streak Associated with Queensland Top Rot Disease. By W. Cottrell-Dormer. *Queensland Agric. Journ.* (1926, **25**, 406–414).

Les Agrumes. Commerce, Culture. By C. Henry. *Bull. Ag. Gén. des Col.* (1926, **19**, 682–690).

Manurial Experiments with Citrus Trees. By W. le Gay Brereton and W. B. Stokes. *Agric. Gaz., N.S.W.* (1926, **37**, 463–468).

Coloring Citrus Fruit in Florida. By W. R. Barger and L. A. Hawkins. *Dept. Bull. No.* 1367, *U.S. Dept. Agric.* Pp. 20, 9½ × 6. (Washington: Government Printing Office, 1926.)

The Storing of Lemons. By F. M. Read. *Journ. Agric., Victoria* (1926, **24**, 292–303).

Report on a Mission to California (U.S.A.) to Study New Methods of Fumigation of Citrus Trees. By Neguib Eff. Iscander. *Bull. No.* 62, *Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 41, 10½ × 7¼. (Cairo: Government Press, 1926.) Price P.T.5.

Spraying Citrus Fruits in Porto Rico. By M. T. Cook and H. L. Dozier. *Circ. No.* 88, *Porto Rico Exper. Sta.* Pp. 23, 9½ × 6. (San Juan, P. R.: Bureau of Printing, 1925.)

The Citrus Bark Borer. By J. P. Tan. *Circ. No.* 177, *Bur. Agric., Manila, Phil. Agric. Rev.* (1925, **18**, 583–584).

Effects of Weather on the World Distribution and Prevalence of Citrus Canker and Citrus Scab. By G. L. Peltier and W. J. Frederick. *Journ. Agric. Res.* (1926, **32**, 147–164).

Further Notes on the Brazil Nut Tree in Malaya. By W. N. Sands. *Mal. Agric. Journ.* (1926, **14**, 125–127).

The Pecan in Arizona. By A. F. Kinnison. *Timely Hints for Farmers, No.* 154, *Arizona Agric. Exper. Sta.* Pp. 22, 9½ × 6. (Tucson, Arizona: State University, 1925.)

Relation of Soil Conditions and Orchard Management to the Rosette of Pecan Trees. By J. J. Skinner and J. B. Demaree. *Dept. Bull. No.* 1378, *U.S. Dept. Agric.* Pp. 16, 9½ × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Commercial Control of Pecan Scab. By J. B. Demaree and J. R. Cole. *Dept. Circ.* 386, *U.S. Dept. Agric.* Pp. 8, 9½ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Fodders and Forage Plants

Composition of Arizona Forages, with Comparative Data. By C. N. Catlin. *Bull. No.* 113, *Arizona Agric. Exper. Sta.* Pp. 19, 9½ × 6. (Tucson, Arizona: State University, 1925.)

Commercial Varieties of Alfalfa. By R. A. Oakley and H. L. Westover. *Farmers' Bull. No.* 1467, *U.S. Dept. Agric.* Pp. 21, 9½ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Die Kultur des Bengalischen Grases auf Java. By C. Ettling. *Tropenpflanzer* (1926, **29**, 222–228).

Subterranean Clover (*Trifolium subterraneum*). By W. J. Spafford. *Journ. Agric., S. Austr.* (1926, **29**, 870–880).

The Clover Leaf Weevil and its Control. By W. H. Lorrimer. *Farmers' Bull. No.* 1484, *U.S. Dept. Agric.* Pp. 5, 9½ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Elephant Grass. A New and Useful Fodder Crop in Western India. By H. H. Mann. *Bull. No.* 127 *of* 1926, *Dept. Agric., Bombay.* Pp. 7, 9½ × 6¼. (Bombay: Superintendent Government Printing, 1926.) Price An.1, or 1*d.*

Johnson Grass. Its Production for Hay and Pasturage. By H. N. Vinall. *Farmers' Bull. No.* 1476, *U.S. Dept. Agric.* Pp. 20, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Soybeans. Production, Composition and Feeding Value. By J. E. Metzger, M. G. Holmes and H. Bierman. *Bull. No.* 277, *Maryland Agric. Exper. Sta.* Pp. 29, 9¼ × 6. (College Park, Maryland, 1925.)

Rayless Goldenrod (*Aplopappus heterophyllus*) as a Poisonous Plant. By C. D. Marsh, G. C. Roe and A. B. Clawson. *Dept. Bull. No.* 1391, *U.S. Dept. Agric.* Pp. 24, 9¼ × 6. (Washington: Government Printing Office, 1926.)

Further Observations on *Stachys arvensis* ("Stagger Weed") as a Cause of Staggers or Shivers in Sheep. By H. R. Seddon, W. L. Hindmarsh and H. R. Carne. *Vet. Res. Rept. No.* 2, *Sci. Bull. No.* 26, *Dept. Agric., N.S.W.* Pp. 25–33. (Sydney: Department of Agriculture, 1926.)

Staggers in Stock due to Rough-bearded Grass (*Echinopogon ovatus*). A Preliminary Account. By H. R. Seddon and H. R. Carne. *Vet. Res. Rept. No.* 2, *Sci. Bull. No.* 26, *Dept. Agric., N.S.W.*, pp. 34–40. (Sydney: Department of Agriculture, 1926.)

Spices

The Vanilla Industry of Netherlands India. *Spice Mill* (1926, **49**, 922–926).

Oils and Oil-Seeds

Annual Report of the Coconut Stations in the Kasaragod Taluk of South Kanara District, Madras, for the Year 1925–26. Pp. 26, 9¾ × 6. (Madras: Superintendent, Government Press, 1926.)

Über die Zukunft der Kokoskultur und Kokosfaserbereitung. By P. Preuss. *Tropenpflanzer* (1926, **29**, 211–222).

The Deodorisation of Coconut Oil. By W. L. Brooke. *Philippine Journ. Sci.* (1926, **30**, 201–212).

Diocalandra taitensis (Guerin) and other Coconut Pests of Fanning and Washington Islands. By W. B. Herms. *Philippine Journ. Sci.* (1926, **30**, 243–274).

Diseases of the Coconut Palm (*cont.*). By A. Sharples. *Mal. Agric. Journ.* (1926, **14**, 91–95).

Coconut Diseases and their Control. By N. G. Teodoro. *Circ. No.* 179, *Bur. Agric., Manila, Phil. Agric. Rev.* (1925, **18**, 585–592).

Phytophthora Bud Rot of Coconut Palms in Porto Rico. By C. M. Tucker. *Journ. Agric. Res.* (1926, **32**, 471–498).

Annual Report of the Groundnut Experiment Station, Palakkuppam, Madras, for the Year 1925–26. Pp. 7, 9¾ × 6. (Madras: Superintendent, Government Press, 1926.)

The Peanut. By H. Wenholz and G. Nicholson. *Agric. Gaz., N.S.W.* (1926, **37**, 457–462; 512–516; *cont.*).

The Peanut in South Africa. By D. Moses and J. P. F. Sellschop. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 369–385).

Marketing Peanuts. By H. J. Clay and P. M. Williams. *Dept. Bull. No.* 1401, *U.S. Dept. Agric.* Pp. 98, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 25 cents.

La Graine Oléagineuse et l'Huile de "Da" (*Hibiscus cannabinus*). By F. Heim de Balsac, G.-S. Dagand, E. Garrigne, M. Husson, J. Maheu and R. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1926, **19**, 530–556).

Étude chimique de la Graine et de l'Huile de Jaboty. By L. Margaillan. *Ann. Mus. Col. Marseille* (33ᵉ ann., 4ᵉ ser., 3ᵉ vol., 1925, 3ᵉ fasc., pp. 37–38).

The Fixed Oil of the Seeds of the "Kurrajong" (*Brachychiton populneum*, R.Br. = *Sterculia diversifolia*, G. Don). By F. R. Morrison. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

Despatches Relating to the Sierra Leone Oil Palm Industry and the Establishment of Oil Palm Plantations. Sessional Paper No. 12 of 1925. (London: Crown Agents for the Colonies, 1925.) Price 1*s*. 6*d*.

Sur les premières recherches de sélection du Palmier à huile à la Côte d'Ivoire (1922, début 1923.) By J. Lavergne. *Agron. Col.* (1926, No. 103, pp. 1–7).

Subsidios para o estudo das palmeiras do azeite da região de Cazengo. By J. Gossweiler and A. A. Monteiro do Amaral. *Publ. diversas III, Fomento Geral de Angola, Missão de Oleaginosos.* Pp. 45, 9 × 6. (Lisbon: Agência Geral des Colónias, 1926.)

Documents sur le palmier à huile à Sumatra. By Y. Henry. *Bull. Écon., Indochine, Nouv. Sér.* (1926, **29**, 1–19).

Experiments on the Germination of African Oil Palm Seeds. By E. A. Curtler. *Mal. Agric. Journ.* (1926, **14**, 84–87).

Les Concasseurs à noix de palme (*cont.*) By G. Passelègue. *Agron. Col.* (1926, **14**, No. 100, pp. 149–161; No. 101, pp. 198–210; No. 102, pp. 229–237; No. 103, pp. 8–19; *cont.*).

Étude chimique des Graines et des Huiles de Pracachy (*Pentaclethra filamentosa*) et d'Owala (*P. macrophylla*). By L. Margaillan, A. Dupuis and J. Rosello. *Ann. Mus. Col. Marseille* (33ᵉ ann., 4ᵉ sér., 3ᵉ vol., 1925, 3ᵉ fasc., pp. 23–28).

Étude microscopique de la Graine et du Tourteau du *Pentaclethra filamentosa*. By P. Choux (*loc. cit.*, pp. 29–36).

Essais divers sur le Beurre de Karité. By G. de Belsunce. *Bull. Mat. Grasses, Inst. Col., Marseille* (1926, No. 3, pp. 55–62).

Le *Thevetia neriifolia*, Juss. By A. Boulay. *Trav. Lab. Mat. Méd. de la Faculté de Pharmacie de Paris*, Vol. XVI, 1925.

Der chinesische Tungölbaum (*Aleurites Fordii*, Hemsl.) im Staate Florida. By J. C. Th. Uphof. *Tropenpflanzer* (1926, **29**, 185–190).

Les Cires et en particulier les Cires végétales. By R. Rousseau. *Trav. Lab. Mat. Méd. de la Faculté de Pharmacie de Paris*, Vol. XVI, 1925.

Essential Oils

The Germicidal Values of some Australian Essential Oils and their Pure Constituents, together with those for some Essential Oil Isolates and Synthetics. Part III. By A. R. Penfold and R. Grant. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

Mimosa (*Acacia dealbata*). By R. Cerbeland. *Parf. Moderne.* (1926, **19**, 99–103).

Bay Oil and Bay Rum. By A. E. Collens and F. H. S. Warneford. Pp. 9½ × 6¼. (Roseau, Dominica: Bulletin Office, 1926.)

The Essential Oil of *Baeckea Gunniana*, var. *latifolia*, F. v. M. By A. R. Penfold. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

The Essential Oil of *Boronia citriodora* and the Occurrence of Citronellol. By A. R. Penfold. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

Essential Oil from Medan Lesoh (*Cinnamomum parthenoxylum*). By B. J. Eaton and Gunn Lay Teik. *Mal. Agric. Journ.* (1926, **14**, 81–83).

The Essential Oil of *Eriostemon myoporoides*, D.C. By A. R. Penfold. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

Some Industrial Uses of the Oil of *Eucalyptus phellandra*. By A. R. Penfold. *Bull. No.* 11, *Technol. Museum, Sydney*. Pp. 6, $8\frac{1}{2} \times 5\frac{1}{2}$. (Sydney: Technical College, 1926.) Price 6*d*.

The Essential Oils of *Melaleuca linariifolia*, Smith, and *M. alternifolia*, Cheel. By A. R. Penfold. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

The Essential Oils from the Leaves of *Murraya Koenigii*, Spreng., *M. exotica*, Linn. and *M. exotica* var. *ovatifoliolata*, Engler. By A. R. Penfold and J. L. Simonsen. Reprinted from *Journ. and Proc. Roy. Soc. of N.S.W.*, Vol. LIX.

"Western" Oil of American Wormseed. *Perf. and Ess. Oil Rec.* (1926, **17**, 180–183).

Fibres

Flax in Wisconsin. By A. H. Wright. *Circ.* 203, *Extension Serv., Coll. of Agric., Wisconsin*. (Madison, Wisconsin: State University, 1926.)

The Pasmo Disease of Flax. By W. E. Brentzel. *Journ. Agric. Res.* (1926, **32**, 25–37).

Valeur textile de Sansevières de l'Oubangui-Chari. By F. Heim de Balsac and O. Roehrich. *Bull. Ag. Gén. des Col.* (1926, **19**, 380–391).

Sericultura Practica. By G. Baleriola. Pp. 54, $8\frac{1}{2} \times 5\frac{3}{4}$. (Madrid: Libería San Martin.)

Cotton

Cotton Cultivation in the Hambantota District and its Place in a Rotation for Dry Zone Agriculture. By G. Harbord. *Trop. Agric., Ceylon* (1926, **66**, 208–213).

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending August 31, 1925. Pp. 122, $9\frac{1}{2} \times 6\frac{3}{4}$. (Bombay: G. Claridge and Co., Ltd., 1925.) Price Rs.2.

Studies in Gujarat Cottons, Part III. The Wagad Cotton of Upper Gujarat, Kathiawar and Kutch. By M. L. Patel and D. P. Mankad. *Mem. Dept. Agric., India, Bot. Ser.* (1926, **14**, 59–112).

India and the Sudan Re-visited. By W. H. Himbury. *Public. No.* 93, *Brit. Cot. Grow. Assoc.* Pp. 64, $8\frac{1}{2} \times 5\frac{1}{2}$. (Manchester: British Cotton Growing Association, 1926.) Price 1*s*.

Kenya, Uganda and Tanganyika as Sources for Increasing our Raw Cotton Supplies. By W. H. Himbury. *Public. No.* 94, *Brit. Cot. Grow. Assoc.* Pp. 64, $8\frac{1}{2} \times 5\frac{1}{2}$. (Manchester: British Cotton Growing Association, 1926.) Price 1*s*.

Report of a Meeting in the Sudan Gezira in December, 1925, for the Discussion of Certain Problems connected with Cotton Growing. Pp. 38, $9\frac{1}{2} \times 6$. (Khartoum: Wellcome Tropical Research Laboratories, 1926.)

The Most Suitable Cotton Variety for the Gezira. By E. E. Canney. *Int. Cotton Bull.* (1926, **4**, 499–502).

Cotton Growing in South Africa. By G. F. Keatinge. *Emp. Cotton Growing Rev.* (1926, **3**, 193–199).

Reports on Experimental Work on Cotton carried out on Certain State Farms in Queensland during 1924–25. Pp. 48, $9\frac{3}{4} \times 6\frac{1}{4}$. (Brisbane: Government Printer, 1926.)

Cotton Prospects in Papua. By G. Evans. *Emp. Cotton Growing Rev.* (1926, **3**, 200–214).

Report on Cotton-Growing Possibilities in the Territory of New Guinea. By G. Evans. *Emp. Cotton Growing Rev.* (1926, **3**, 215–234).

The Effect of the Sharâqi Period upon the Yield of Cotton in Egypt. By E. McTaylor. *Bull. No. 57, Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 22, 10¾ × 7. (Cairo: Government Press, 1926.) Price P.T.5.

Cotton Production in the United States. Crop of 1925. *Bur. of Census, U.S. Dept. Comm.* Pp. 40, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Report on Missouri Cotton Experiment Fields, 1925. By B. M. King. *Circ.* 141, *Agric. Exper. Sta., Missouri.* Pp. 7, 9¼ × 6. (Columbia, Missouri: State University, 1926.)

Report to the Members of the International Cotton Federation on the Journey of the Cotton Mission to the Republic of Colombia. By A. S. Pearse. *Int. Cotton Bull.* (1926, **4**, 465–470).

The Deterioration of the Peruvian Tanguis Cotton. By J. H. Pardo. *Int. Cotton Bull.* (1926, **4**, 485–488).

Gossypium. By Sir George Watt. *Kew Bulletin* (No. 5, 1926, pp. 193–210).

Le Coton sec. (*cont.*) By M. Etesse. *Agron. Col.* (1926, **14**, No. 101, pp. 189–197; No. 102, pp. 253–259).

Cotton Fertiliser Trials. By T. D. Hall. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 234–248).

The Principles and Practice of Yield Trials. By F. L. Engledow and G. Udney Yule. *Emp. Cotton Growing Rev.* (1926, **3**, 234–248).

The Pink Bollworm, with Special Reference to Steps taken by the Department of Agriculture to Prevent its Establishment in the United States. By W. D. Hunter. *Dept. Bull. No.* 1397, *U.S. Dept. Agric.* Pp. 30, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Studies of the Pink Bollworm, in Mexico. By L. Ohlendorf. *Dept. Bull. No.* 1374, *U.S. Dept. Agric.* Pp. 64, 9 × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

The Pink Bollworm of Queensland. By F. G. Holdaway. *Bull. Entom. Res.* (1916, **17**, 67–83).

Life History and Habits of the Thurberia Bollworm (*Thurberiphaga diffusa*, Barnes.) By C. T. Vorhies. *Tech. Bull. No.* 7, *Arizona Agric. Exper. Sta.* Pp. 22, 9¼ × 6. (Tucson, Arizona: State University, 1926.)

Behaviour of Cotton Root Rot at Greenville, Tex., including an Experiment with Clean Fallows. By H. C. McNamara. *Journ. Agric. Res.* (1926, **32**, 17–24).

Experiments on the Control of Cotton Root Rot in Arizona. By C. J. King and H. F. Loomis. (*loc. cit.*, pp. 297–310).

A Leaf, Bract and Boll Spot of Sea Island Cotton caused by *Helminththosporium gossypii*, nov. sp. By C. M. Tucker. *Journ. Agric. Res.* (1926, **32**, 391–395).

Results of Spinning Tests on Standard Indian Cottons. *Indian Central Cotton Committee, Technological Laboratory.* Pp. 89, 9¼ × 7. (Bombay: G. Claridge & Co.)

Rubber

Le Caoutchouc dans l'Ouest de Java (*cont.*) By M. Guillaume, *Agron. Col.* (1926, **14**, No. 100, pp. 171–178; No. 101, pp 211–217; No. 102, pp. 20–25).

The Budding of Rubber. The Present Position. By F. A. Stockdale. *Trop. Agric., Ceylon* (1926, **67**, 3–6).

General Principles of Selection and their Application to Hevea. *Trop. Agric., Ceylon* (1926, **66**, 287–290).

Bemestingsproeven in Rubbertuinen [Manuring Experiments in Rubber]. By J. F. Schmöle. *Arch. v. de Rubbercultuur* (1926, **10**, 233–288; summary in English, pp. 289–301).

Report on Rubber Tapping Experiments for 1925, Experiment Station, Peradeniya. *Trop. Agric., Ceylon* (1926, **66**, 323–327).

Deep Tapping *versus* Shallow Tapping. By H. Ashplant. *Bull. Rubber Growers' Assoc.* (1926, **8**, 340–344).

Vergelijkende Proeftappingen bij Hevea Zaailingen en Oculaties van ongekeurde Clonen [Comparative Experiment Tappings on Hevea Seedlings and Buddings from Unproved Clones]. By E. Durheim and C. Heusser. *Arch. v. de Rubbercultuur* (1926, **10**, 198–204; in English, pp. 205–209). [Also issued as *Med. Algem. Proefsta. der A.V.R.O.S., Rubberserie No.* 45, 1926.]

Over de Toepassing van de in de Rubbercultuur gebrukelijke Desinfectiemiddelen [The Application of Disinfectants used in the Cultivation of Rubber]. By A. Steinmann and J. J. B. Deuss. *Arch. v. de Rubbercultuur* (1926, **10**, 159–181; full summary in English, pp. 182–198).

Methods for Prevention and Control of Disease in Para Rubber Cultivation. By J. Mitchell. *Trop. Agric., Ceylon* (1926, **66**, 278–282).

The Spraying of Rubber as a Means of Control of Secondary Leaf-Fall. By R. H. Stoughton-Harris. *Bull. Rubber Growers' Assoc.* (1926, **8**, 333–337).

"Sun Scorch" of Exposed Lateral Roots of *Hevea brasiliensis*. By A. Sharples. *Mal. Agric. Journ.* (1926, **14**, 116–118).

The Effect of Fern and other Growth on the Health and Growth of the Rubber Tree. By F. G. Spring. *Mal. Agric. Journ.* (1926, **14**, 119–124).

De Bereiding van Zoolcrêpe [The Manufacture of Sole Crêpe]. By H. W. Blommendaal. *Arch. v. de Rubbercultuur* (1926, **10**, 214–219; in English, pp. 220–225). [Also issued as *Med. Algem. Proefsta. der A.V.R.O.S., Rubberserie No.* 46, 1926.]

Tobacco

The History and Importance of Tobacco Production in Jugoslavia. By G. Gordon-Smith. *Tobacco* (1926, **82**, No. 3, pp. 9–10).

Méthodes de Culture et de Préparation du Tabac de cape appliquées au Tonkin par la "Société des Tabacs de l'Indochine." By H. le Lorrain and J. Goubeaux. *Bull. Écon. Indochine, Nouv. Sér.* (1926, **29**, 125–158).

Jaarverslag van het Proefstation voor Vorstenlandsche Tabak, May 1, 1923–April 30, 1924. By A. d'Angremond. *Med. No.* 53, *Proefsta. voor Vorstenlandsche Tabak, Ned. E. Ind.*, 1926, pp. 7–48.

(1) Plukproeven op Djoewiring, 1921–22, Gantiwarno 1924–25, Pandang Siemping, 1922–23 en 1923–24. (2) Proef met beschaduwing van den aanplant op Troetjoek, 1923–24. (3) Topproef op Ngoepit, 1923–24. By A. N. J. Beets. *Med. No.* 53, *Proefsta. voor Vorstenlandsche Tabak, Ned. E. Ind.*, 1926, pp. 48–84. (Summary in English pp. 85–88.)

(1) Zaadbeddenbemestingsproeven op de Onderneming Djoewiring, 1923–24 en 1924–25. (2) Aanteekeningen omtrent de mate van uitspoeling van kunstmest; vergelijking van verschillende grondsoorten in gebruik bij de Vorstenlandsche Tabakskultuur. (3) Bemestingsproeven 1923–24 en 1924–25. By A. N. J. Beets. *Med. No.* 54, *Proefsta. voor Vorstenlandsche Tabak, Ned. E. Ind.*, 1926, pp. 1–106. (Summary in English, pp. 107–109.)

The Green June Beetle Larva in Tobacco Plant Beds. By V. B. McKinney and J. Milam. *Farmers' Bull. No.* 1489, *U.S. Dept. Agric.*

Pp. 5, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Diseases of Tobacco in the Philippines. By F. M. Clara. *Circ. No.* 171, *Bur. Agric., Manila, Phil. Agric. Rev.* (1925, **18**, 564–570).

Drugs

Chaulmoogra et autres Graines utilisables contre la Lèpre. By Ém. Perrot. Notice No. 24, Office National de Matières premières végétales pour la Droguerie, la Pharmacie, la Distillerie et la Parfumerie. Ministère du Commerce et de l'Industrie. Pp. 59, 9½ × 6¼. (Paris, 1926.) Price 15 frs.

Contribution à l'Étude de la Noix de Cola. Les Colatiers au Congo belge (*cont.*). By L. L'Heureux and J. Pieraerts. *Agron. Col.* (1926, **14**, No. 102, pp. 238–252).

Contributions à l'Étude des Genêts indigènes. By R. Jolivet. *Trav. Lab. Mat. Méd. de la Faculté de Pharmacie de Paris,* Vol. XVI, 1925.

Dyestuffs

African Leather Dyes. By J. M. Dalziel. *Kew Bull.,* No. 6, 1926, pp. 225–238.

Miscellaneous Agricultural Products

Les Utilisations des Algues et Plantes Marines. By M. Deschiens. *Chim. et Indust.* (1926, **15**, 675–698).

The "Downy Mildew" or "Spike-Disease" of the Hop in 1925. By E. S. Salmon and W. M. Ware. *Journ. Min. Agric.* (1926, **33**, 149–161).

FORESTRY

General

Sixth Annual Report of the Forestry Commissioners, for the Year ending September 30, 1925. Pp. 32, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 9*d*.

A Short Description of the Forests of Cyprus. By A. H. Unwin. Pp. 28, 8½ × 5½. (Nicosia: Government Printing Office, 1925.) Price 2/4½ c.p.

Annual Progress Report on Forest Administration in the Presidency of Bengal for the Year 1924–25. Pp. 43, 13 × 8½. (Calcutta: Bengal Secretariat Book Depot, 1926.) Price Rs.2, As.10, or 5*s*.

Annual Report of the Forest Administration in the Bombay Presidency, including Sind, for the Year 1924–25. Pp. 226, 9½ × 6¼. (Bombay: Superintendent, Government Printing, 1926.) Price Rs.4, As.9, or 7*s*. 9*d*.

Report on Forest Administration in Burma for the Year ending March 31, 1925. Pp. 224, 9¾ × 6½. (Rangoon: Superintendent, Government Printing, 1926.) Price Rs.5 (7*s*. 6*d*.).

Report on Aerial Reconnaissance, Stockmapping and Photography of the Forests of the Tavoy and Mergui Districts (South Tenasserim Forest Division). January to April, 1925. By C. W. Scott and C. R. Robbins. *Burma For. Bull. No.* 13 (*Misc. Ser. No.* 2). Pp. 76, 13 × 8¼. (Rangoon: Superintendent, Government Printing, 1926.) Price Rs.2 (3*s*.).

Annual Report on Sylviculture and Forest Research in the Central Provinces and Berar, 1924–25. Pp. 32, 9¾ × 7½. (Nagpur: Government Press, 1925.) Price Rs.6.

Progress Report of Forest Administration in Coorg for 1924–25. Pp. 15 + 17, 13 × 8¼. (Bangalore: Mysore Residency Press, 1926.) Price As.12.

Administration Report of the Forest Department of the Madras Presidency for the Year ending March 31, 1925. Vol. I. Pp. 160, Vol. II. Pp. 161, 10 × 6½. (Madras: Superintendent, Government Press, 1926.) Price, Vol. I, Rs.1, As.8, Vol. II, As.12.

Progress Report on Forest Administration in the Punjab for the Year 1924–25. Pp. 48 + clxix, 10 × 7. (Lahore: Superintendent, Government Printing, 1925.) Price Rs.6, As. 8, or 8*s.* 8*d.*

Report on Forest Administration, Federated Malay States, for the Year 1925. Pp. 59, 13 × 8¼. (Supplement to the *F.M.S. Government Gazette*, June 11, 1926.)

Annual Report, Forest Department, Kenya, 1925. Pp. 36, 9¾ × 6¼. (Nairobi: E. A. Standard, Ltd., 1926.)

Fourth Annual Report of the Forest Department, Tanganyika Territory, 1924. Pp. 16, 13 × 8¼. (Dar es Salaam: Government Printer.) Price 2*s.* 6*d.*

Exploitation of Forests in Uganda. By R. Fyffe. *Emp. For. Journ.* (1926, **5**, 60–67).

Report of the Forest Department, Union of South Africa, for the Year ended March 31, 1925. *Ann. Dept. Repts. No.* 5, pp. 382–411. (Pretoria: Government Printing Office, 1926.) Price 5*s.*

Some South African Forests. By G. Leather. *Quart. Journ. Forestry* (1926, **20**, 209–221).

Report of the Director of Forestry, Canada, for the Year ended March 31, 1925. Pp. 31, 9¾ × 6½. (Ottawa: Government Printer, 1926.)

The Development of Forestry in Western Australia. By S. L. Kessell. *Emp. For. Journ.* (1926, **5**, 26–31).

Forestry in Victoria. By O. Jones. *Emp. For. Journ.* (1926, **5**, 87–101).

Report on the Forest Resources of the Territories of Papua and New Guinea. By C. E. Lane-Poole. Pp. 209, 13 × 8¼. (Melbourne: Government Printer for the State of Victoria, 1926.) Price 7*s.* 6*d.*

Report on the Forests of Norfolk Island. By C. E. Lane-Poole. Pp. 35, 13 × 8¼. (Melbourne: Government Printer for the State of Victoria, 1926.)

Les Forêts Congolaises et leurs Principales Essences Économiques. By É. de Wildeman. *Bibliothèque-Congo, No. XIX.* Pp. 214, 9¾ × 6½ (Brussels: Goemare, 21, rue de la Limite, 1926.)

Onderzoek naar de natuurlijke verjonging en den uitkap in Preanger gebergtebosch. By F. Kramer. *Med. No.* 14, *Proefsta. voor het Boschwezen, Ned. E. Ind.* Pp. 210, 11 × 7½. (Wagingen: H. Veenman en Zonen, 1926.)

Timber Growing and Logging Practice in the California Pine Region. By S. B. Show and W. B. Greeley. *Dept. Bull. No.* 1402, *U.S. Dept. Agric.* Pp. 75, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Longleaf Pine Primer. By W. R. Mattoon. *Farmers' Bull. No.* 1486, *U.S. Dept. Agric.* Pp. 32, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Forest and Timber Insects in New Zealand. By D. Miller. *Bull. No.* 2, *New Zealand State Forest Service.* Pp. 76 + 90 plates, 9¾ × 6¼. (Wellington: Government Printer, 1925.) Price 4*s.*

The Silver Fir Chermes. By R. N. Chrystal. *Bull. No.* 7, *Forestry Commission.* Pp. 27, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 1*s.* 6*d.*

Chestnut Blight in the Southern Appalachians. By G. F. Gravatt

and R. P. Marshall. *Dept. Circ.* 370, *U.S. Dept. Agric.* Pp. 11, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Maple Wilt. By G. F. Gravatt. *Dept. Circ.* 382, *U.S Dept. Agric.* Pp. 13, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

The Phomopsis Disease of Conifers (*Phomopsis Pseudotsugæ*, Wilson). *Leaflet No.* 14, *Forestry Commission.* (London: Forestry Commission, 1926.) Gratis.

Preliminary Investigation into the Cause and Cure of the Spike Disease in Sandal (*Santalum album*) in the North Salem District, Madras. By W. C. Hart and S. Rengaswamy. *Ind. For.* (1926, **52**, 373–390).

Trametes Pini on Deodar in the Baspa Valley, Bushahy State, Punjab. By Parma Nand Suri. *Ind. For.* (1926, **52**, 327–330).

Timbers

Report on the Equipment Necessary for A.—Experimental Research on the Properties of Malayan Timbers. B.—Economic Exploitation of a Malayan Forest Reserve. By H. T. M. Kent. *Federal Council Paper No.* 30, 1925, *F.M.S.* Pp. 123, 13 × 8½. (Kuala Lumpur: Government Printing Office, 1926.)

List of Trade Names for Indian Timbers. *Ind. For.* (1926, **52**, 331–340).

The Naming of Woods. By E. H. F. Swain. *Queensland Agric. Journ.* (1926, **15**, 433–441). [Includes full list of botanical and common names of Queensland woods.]

Les bois coloniaux d'Afrique dans l'industrie (*cont.*). By J. Meniaud and F. Bretonnet. *Bull. Ag. Gén. des Col.* (1926, **19**, 335–348; 503–518; 667–681; to be continued).

Mechanical Properties of Dutch East Indian Timbers. By L. G. den Berger. *Korte Med. No.* 12, *Proefsta. voor het Boschwezen, Ned. E. Ind.* Pp. 63, 9½ + 6½. (Weltevreden: Landsdrukkerij, 1926.)

Houtsoorten der Cultuurgebieden van Java en van Sumatra's Oostkust. By L. G. den Berger. *Med. No.* 13, *Proefsta. voor het Boschwezen, Ned. E. Ind.* Pp. 186 + atlas of 31 plates, 11 × 7½. (Wagingen: H. Veenman en Zonen, 1926.) Also issued as *Med. van het Proefsta. voor Thee, No. XCVII.* (Batavia: C. Kolff & Co., 1926.)

De Houtsoorten van Suriname. By J. Ph. Pfeiffer. Deel I. *Med. No. XXII, Afdeel. Handelsmuseum No.* 6, *Kon. Ver. Kol. Inst., Amsterdam.* Pp. 505 + atlas of 24 plates, 9 × 6½. (Amsterdam: Druk de Busay, 1926.) Price fl.10.

Notes on the Principal Indigenous Timbers of the Natural Order Saxifragaceæ. By M. B. Welch. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

The Identification of the Principal Ironbarks and Allied Woods. By M. B. Welch. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

Productie van Djatihout in Britisch-Indië, Siam en Nederlandsch Indië. By A. J. Warta. *Tectona* (1926, **19**, 493–507; summary in English, pp. 507–508).

East African Pencil Cedar. By H. M. Gardner. *Emp. For. Journ.* (1926, **5**, 39–53).

Hardwood Problems in Burma. By W. A. Robertson. *Emp For. Journ.* (1926, **5**, 73–77).

Kiln Seasoning of Indian Timbers. By S. Fitzgerald and S. N Kapur. *Project No. VII, Econ. Br., For. Res. Inst., Dehra Dun, India.* Pp. 30, 9¾ × 7. (Calcutta: Government of India Central Publication Branch, 1926). Price Rs.1, As.4, or 2*s.*

Preliminary Notes on the Seasoning of Local [Trinidad] Timber. By R. C. Marshall. *Proc. Agric. Soc., Trinidad* (1926, **26**, 197–212).

The Movement of Moisture with Reference to Timber Seasoning. By S. T. C. Stillwell. *Tech. Paper No.* 1, *For. Prod. Res., Dept. Sci. and Indust. Res.* Pp. 29, 9½ × 7¼. (London: H.M. Stationery Office, 1926.) Price 1*s*. 6*d*.

Tanning Materials

Une Anacardiacée tannifère nouvelle du Congo belge. Le Gonyo (*Antrocaryon Nannani*, de Wild.) By J. Pieraerts. *Agron. Col.* (1926, **14**, No. 100, pp. 162–170).

The Tannins of the Black Cypress Pine (*Callitris calcarata*, R. Br.) and their Distribution in the Bark. By F. A. Coombs, W. McGlynn and M. B. Welch. Reprinted from *Journ. and Proc., Roy. Soc. of N.S.W.*, Vol. LIX.

Les Palétuviers d'Indochine. Intérêt de leur exploitation, valeur technologique, comparaison avec des palétuviers d'autres origines. By R. Heim de Balsac, A. Deforge, J. Maheu and A. Parveaud. *Bull. Ag. Gén. des Col.* (1926, **19**, 714–738).

NOTICES OF RECENT LITERATURE

The Dominions and Colonial Offices. By Sir George V. Fiddes, G.C.M.G., K.C.B. Pp. 288, 7¾ × 5¼. (London: G. P. Putnam's Sons, Ltd., 1926.) Price 7*s*. 6*d*.

This is the fourth work to appear in a special series of books which the publishers are issuing on the Government Departments of Great Britain. The author briefly describes the development and present working of the Colonial Office, with suitable references to the recently formed Dominions Office, but a large part of the book is devoted to an account of the administrative history and present modes of government of the principal Colonies and Dependencies. Much is also said on the Dominions, and on certain financial, racial and other problems of special importance in various parts of the Empire.

Sir George Fiddes has compiled a useful and readable summary of information not usually accessible in such a handy form. From his long experience at the Colonial Office he is specially qualified to deal with his subject, and the book can be recommended both to present and prospective colonial officials and to all students of colonial history and administration.

Handbook to British Malaya, 1926. Compiled by Capt. R. L. German, Malayan Civil Service. Pp. 183, 8½ × 6¼. (London: Malay States Information Agency.) Price 2*s*. 6*d*. post free.

This official handbook is a well-printed and attractively illustrated publication, dealing in a practical manner with

the Straits Settlements and the Federated and Unfederated Malay States. The information, which is excellently arranged, covers a wide field, and will prove of value not only to readers with commercial and industrial interests in Malaya, and to tourists, but also to those concerned with the region as students of colonial economics or administration.

A number of errors in the botanical names quoted on pages 93–97 might suitably be corrected in the next edition of the Handbook.

ECONOMIC GEOGRAPHY OF SOUTH AMERICA. By R. H. Whitbeck, Professor of Geography, University of Wisconsin. Pp. vii + 430, $9\frac{1}{4} \times 6\frac{1}{4}$. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 17*s.* 6*d.*

In this attractive volume Professor Whitbeck has furnished an interestingly written and most instructive survey of South America. Physical geography, topography, social and economic conditions, agriculture, mining, manufactures and commerce, are all admirably dealt with. Each of the constituent countries is separately described, and much light is thrown on the conditions and circumstances which have tended, and are still tending, to differentiate communities which are to no small extent of similar origin. Numerous photographs, maps and diagrams, and several useful bibliographies, are included in the work, which can be confidently recommended to students of economic geography and to other readers desiring practical information on the countries of South America.

STATISTICAL ATLAS OF THE BOMBAY PRESIDENCY. Third Edition. Prepared and revised by the Director of Agriculture. 17×14. With 194 pp. of text and numerous maps and charts. (Bombay: Government Central Press, 1925.) Price Rs.30 or £2 6*s.* 5*d.*

In order to provide a useful guide, especially in times of famine, to officers detailed for duty in regions with which they are not already acquainted, an illustrated statistical account of the conditions of each district included in the Presidency was first prepared in 1888. The present edition should have appeared in 1916, but owing to the abnormal conditions prevailing then and subsequently, revision could not be undertaken until 1923. The delay, however, has provided the opportunity to compare conditions existing in a post-war normal year (1922–23) with those prevailing in a year (1918–19) when one of the most serious and widespread famines of recent times occurred.

The atlas is remarkable for the wealth of information which it contains relating to the geographical, economic and social conditions of the Presidency, while a novel feature of the third edition is the attempt to illustrate by subsidiary maps and diagrams conditions as to the principal crops, amount and kind of irrigation, changes in number of cattle, and the severity of recent famine years in each district.

Short historical accounts of famines, locust and rat plagues, and floods are also included. The tabular matter is well arranged and informative.

Co-operation and Competition in the Marketing of Maize in South Africa. By Herbert Frankel, M.A. Pp. xi + 144, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: P. S. King & Son, Ltd., 1926.) Price 8*s.* 6*d.*

This essay is based upon a thesis approved for the degree of Master of Arts in Economics in the University of the Witwatersrand, Johannesburg. The writer's investigations into the subject involved the assembling of a considerable amount of data relating to the working of the co-operative societies in South Africa since they were started in the years of agricultural depression following the Boer War. The result has been to convince him that the action of the Government in fostering co-operative marketing and affording assistance to the societies has not genuinely benefited the maize growers, and that whatever may be the advantages of this system as applied to perishable commodities such as fruit, vegetables and dairy produce, prosperity in the maize trade is more likely to be achieved by well organised competition.

He sees in the newly established elevator system a prospective solution to many of the difficulties that have beset the South African maize trade during its infancy, and he advocates the formation of a grain exchange with a view to facilitating the carrying out of contracts, the establishment of an organised futures market, and the protection of merchants from the inconveniences due to price fluctuations and other disturbing elements.

The Clove of Commerce (Zanzibar and Pemba), Including Cost and Charges Calculator. By W. Grazebrook. Pp. 81, $9\frac{3}{4} \times 6\frac{1}{4}$. (London: The Commercial Calculating Co., Ltd.; East Africa: Grazebrook, Bartlett & Co., P.O. Box 26, Tippu Tib House, Zanzibar, 1925.) Price 15*s.*

This handbook is designed for the assistance of various classes of persons concerned in the clove trade, and can

be recommended as a concise and practical guide to the commercial side of the industry. It gives an account of the methods and conditions of marketing in Zanzibar and Pemba and in the chief importing countries, and includes a number of statistical tables and "ready-reckoners" which should be of considerable utility.

De Notemuskaatcultuur in Nederlandsch-Indië, sedert de Opheffing van het Monopolie. By A. H. W. M. Hermans. Pp. xii + 111, 9½ × 6.

This work is a reprint of a thesis presented by the author for his degree at the University of Amsterdam. In the early days of Dutch occupation in the East Indies an attempt was made to limit the production of nutmegs to certain islands. This embargo was removed in 1864. The present volume deals very comprehensively with the subsequent history, development, and present position of the nutmeg industry in the Dutch East Indies. A large section of the book is also devoted to the constituents of the nutmeg, including the author's own researches on the characters and composition of the essential oils of nutmeg and mace obtained from fruits grown in the different islands.

Chaulmoogra et Autres Graines Utilisables contre la Lèpre. By Em. Perrot. Ministère du Commerce et de l'Industrie. Travaux de l'Office National des Matières premières végétales, Notice No. 24, April 1926. Pp. 59, 9½ × 6. (Lons-le-Saunier: Imprimerie L. Declume, 1926.) Price 15 francs.

Les Huiles de Chaulmoogra. Leurs Origines, leurs Caractères et leur mode d'action. By Dr. René Lucien Jumelle. Pp. 87, 10 × 6½. (Orleans: Imprimerie Henri Tessier, 1926.)

The first of these monographs gives a brief survey of the botanical history and describes in detail the most important of the trees bearing seeds containing oils which are beneficial in the treatment of leprosy and tuberculosis. Among those mentioned are *Taraktogenos Kurzii* (yielding chaulmoogra oil), *Hydnocarpus anthelminthicus* and other *Hydnocarpus* species, *Asteriastigma macrocarpa*, *Carpotroche brasiliensis* and *Oncoba echinata*. The author gives a résumé of the attempts that have been made to cultivate trees of this group, the chief trials having been made in Hawaii Islands with *T. Kurzii*, *H. castanea* and

H. anthelminthicus with promising results. Other chapters are devoted to the toxicity of the *Flacourtiaceæ*, to which Natural Order these trees belong; the extraction and chemical composition of the oils from the different seeds; the preparation of ethyl esters from the fatty acids present in the oils and the use of these oils and esters in the treatment of leprosy and tuberculosis. The book is illustrated with a number of plates and text figures.

The other monograph by Jumelle treats of the subject of chaulmoogra oils from the medical point of view. The first two chapters deal with the chemical composition of chaulmoogra and allied oils. The remaining two describe the methods employed in administering these drugs and the action they have upon the system. Formerly the oils were taken *per os* either in the form of oil, fatty acids, or salts or esters of the fatty acids. This method of administration has now been largely abandoned on account of the gastric trouble that followed and the slowness of the action of the drug when introduced by the mouth. It is now considered preferable to inject the esters of the fatty acids either intravenously or intramuscularly. The author states that experience appears to show that hydnocarpic acid and its compounds are more active than chaulmoogric acid and its corresponding compounds. A good bibliography is given at the end of the book.

THE CHEMISTRY OF RUBBER MANUFACTURE. Based on the Fifth Edition of *The Chemistry of India Rubber*, by Carl Otto Weber. By Lothar E. Weber, Ph.D. Pp. xii + 372, 9 × 6. (London: Charles Griffin & Co., Ltd., 1926.) Price 21*s*.

For many years Carl Otto Weber's book on *The Chemistry of India Rubber* was the standard text-book of rubber technologists. The author of the present volume is Weber's son, a well-known rubber expert. He proposed to revise his father's work, but found that so many changes had occurred in the industry during the last twenty years that mere revision was not sufficient, but that the whole of the matter would have to be re-written. The present volume, therefore, is essentially a new work, although the broad outline of the earlier book has been retained. It deals with the preparation and properties of raw rubber, vulcanisation, compounding, reclaiming, synthesis of rubber, and the physical and chemical examination of vulcanised rubber.

The book will doubtless be of great service to rubber chemists and manufacturers.

THE FORESTS OF INDIA. By E. P. Stebbing, M.A. Vol. III. Pp. xviii + 705, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: John Lane, The Bodley Head Ltd., 1926.) Price 42*s.*

The two earlier volumes of this work have already been noticed in this BULLETIN (1922, **20**, 419 and 1923, **21**, 658) and a further description of its scope and character is unnecessary. It need only be said that this final section of Professor Stebbing's comprehensive treatise is in every respect as worthy of perusal and careful study as its predecessors, and will be of great practical interest to forest officers throughout the British Empire.

As regards India in particular, Professor Stebbing points out (p. 680) that even now "the Forest Officer is only at the commencement of a gigantic task"; but there is no doubt that, in that task, present and future officers will be able to derive most valuable assistance from the three volumes now completed.

LES FORÊTS CONGOLAISES ET LEURS PRINCIPALES ESSENCES ÉCONOMIQUES. By É. de Wildeman. Pp. 214, $10 \times 6\frac{1}{2}$, with Map. (Brussels: Goemaere, Imprimeur du Roi, 1926.)

In writing this volume Dr. de Wildeman has added another item to his long list of contributions to a knowledge of the botanical resources of the Belgian Congo. With the increasing attention that is being given to the utilisation of the timbers of tropical Africa, not only in commerce, but in the countries of origin in place of imported timbers, it is opportune that information should be furnished regarding the timber resources of the Belgian Congo. The author has divided his work into two main sections, the first dealing with the general circumstances of the forests of tropical Africa and the conditions governing their commercial exploitation, the second section being specifically concerned with the timber resources of the Congo. In the former part he refers to the view held in certain quarters that western tropical Africa must be regarded as the source of timber supplies to meet the increasing needs of western Europe, and draws attention to the need of proper conservation of the forests if they are not to be exhausted. He refers to measures taken towards this end in different countries, and in this connection quotes (no doubt with approval) the "Bye-Laws for Conserving Forests in the Gold Coast Colony" (1924), to which he refers as "une législation forestière très draconienne." This section also contains the list of the principal West African woods actually imported into

France which was prepared for the Timber Congress held at Grenoble in 1925. This list includes upwards of twenty botanical species.

In the second part attention is drawn to the outstanding importance from the commercial point of view of two forest regions of the Congo, viz. the district of Mayumbe and the equatorial forest region. The author quotes some sixty-eight genera yielding useful timbers as occurring in Mayumbe, the Leguminosæ being especially well represented. The corresponding list for the equatorial region, though apparently not so numerous, shows a marked botanical relationship to the former and resembles it in the abundance of Leguminosæ. This section contains a questionnaire compiled by the author and suggested by him as affording a scheme for the collection on a uniform plan of data regarding the constituents of a forest; the scheme provides for botanical particulars of each tree and information regarding the timber and its uses. The book concludes with a list of the trees in the Congo furnishing useful timbers, with descriptions of the woods. An excellent map is provided.

OXFORD FORESTRY MEMOIRS, NO. 4, 1926. MEASUREMENT OF THE CUBICAL CONTENTS OF FOREST CROPS. By M. D. Chaturvedi, B.Sc. Oxon. Pp. xv + 142, 10¾ × 7½. (London: Humphrey Milford, Oxford University Press, 1926.) Price: paper, 10*s.*; cloth, 12*s.* 6*d.*

The author describes this work as "a critical investigation into the methods of measuring sample plots with special reference to the liability to error." The book consists of two portions. Part I, under a sub-title of "General Remarks," deals with the determination of the volume of single trees, the theory of the sample tree, the determination of the mean basal area and the mean height of a stand, the number of sample trees, the calculation of the volume of a sample tree, and concludes with a brief table giving a description of the test plots used in the course of this work.

Part II is concerned with the "Measurement of the Cubical Contents of Woods" and investigates the various sample tree methods, which comprise the arithmetical mean sample tree method and eight group methods; the abstract sample tree methods, consisting of statistical and graphical methods; and finally a number of miscellaneous methods. In conclusion, the question is discussed as to which method it is best to adopt for a given case.

A full bibliography is appended.

The Kiln Drying of Lumber. By Arthur Koehler, B.S., and Rolf Thelen, B.S. Pp. x + 293, $9\frac{1}{4} \times 6$. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 15s.

The importance of kiln-drying lumber scientifically has been more fully realised in recent years and a good text-book on the subject will be welcomed by those manufacturers of wood products who desire to increase the efficiency of their kiln-drying plant or to expand their kiln capacity. This book, which contains much valuable information given in a simple and practical manner, commences with a general discussion on kiln-drying, and this is followed by several chapters dealing with the structure of wood in relation to its drying, the "sap" or moisture content of wood, its shrinkage and collapse. Later chapters are concerned with types of dry kilns; the heat in a dry kiln; humidity and evaporation; circulation and piling of lumber in a kiln; kiln selection, layout and construction; the operation of a dry kiln and miscellaneous considerations involved in kiln-drying timber.

Throughout the work, the importance of correctly controlling the temperature, humidity and circulation in the kiln is emphasised, as success in drying lumber is dependent on it.

A Manual of the Flowering Plants and Ferns of the Transvaal with Swaziland, South Africa. By Joseph Burtt Davy. Part I. Pteridophyta to Bombacaceæ. Pp. 271, $7\frac{3}{4} \times 5\frac{1}{4}$. (London: Longmans, Green & Co., Ltd., 1926.) Price 15s.

The provision of an accurate and convenient "flora" is the surest means of promoting the study of the native plants of a country and usually leads to an increase of knowledge proportional to the possibilities of the case and the excellence of the handbook. Botanists and other plant lovers in the Transvaal and Swaziland (and countries adjacent) are to be envied in their present position. Living in a region rich in native plants, but still incompletely explored botanically, they will now be in possession of a guide which will enable them to identify the great majority of their collections and stimulate them to carry on investigation which offers no small prospect of adding tangibly to the knowledge of the flora of their countries.

The reputation and experience of the author ensure the highest degree of accuracy of the text that can be expected in the first issue of a new flora, and this notice

is therefore confined to an appreciation of the convenience of the Manual to the working botanist. The author states that in dealing with some 4,500 species practical considerations of cost have necessitated the adoption of a compromise between a fully descriptive flora and a mere catalogue of plant names. The compromise is on the general lines of Prain's *Bengal Plants* and other floras of similar arrangement, and consists of dichotomous keys to the families, genera and species, followed by an account of the geographical range of each species, the quotation by number of all specimens critically examined by the author, and notes of economic interest. The basis of the Manual is the *Check List of Transvaal Plants* published by the author and Mrs. Leendertz Pott in 1911. The arrangement of the families is of particular interest, since the Manual is the first local flora in which use is made of the new classification put forward by Hutchinson in the projected revision of Bentham and Hooker's *Genera Plantarum*, to the manuscript of which Dr. Burtt Davy had access before the appearance of the syllabus of the new scheme issued recently as *Families of Flowering Plants*.

The opening pages of this first part of the Manual include an analytical key to the groups and families (excluding monocotyledons), a synopsis and tabular view of families included in the volume, diagnoses (in Latin) of some 130 new species and varieties, a glossary of terms and hints on plant-collecting. The volume deals with the Pteridophyta, Gymnosperms and the dicotyledonous families from Anonaceæ to Bombacaceæ (in the Hutchinson sequence) : in all some eight orders and families are concerned. The text is accompanied by frequent excellent illustrations by Mr. W. E. Trevithick, assistant artist to the Kew Herbarium, and Mrs. Burtt Davy ; and there are sketch maps showing the botanical regions of Africa and the five botanical provinces of the Transvaal recognised by the author.

Examination of the text has led to very favourable impressions. The keys appear to be workmanlike and convincing, while in the accounts of the distribution of the species the author has frequently compressed a large amount of valuable and interesting information. Practical features in the format of the work which mean so much to the use of a hand flora have been carefully studied. The size of page is convenient, the paper thin and the printing excellent. A skilful and apparently faultless use of stops and abbreviations has rendered possible the record of a mass of information of the kind desired by the field botanist. There can be no doubt that Dr. Burtt Davy's

book will prove a landmark in the history of South African field botany.

COLLOID CHEMISTRY: THEORETICAL AND APPLIED. By selected international contributors. Collected and edited by Jerome Alexander. Volume I. Theory and Methods. Pp. 974, 9¼ × 6¼. (New York: The Chemical Catalog Company, Inc., 1926.) Price $14.50.

The book consists of sixty papers written by experts of international reputation on subjects to which they have made important contributions from time to time. Some of the different papers present diverse and conflicting views, but the Editor expresses the opinion that although this method of presenting the subject may be less satisfying than the method of dogmatic statement commonly used in text-books, it will lead the reader nearer to the truth and tend towards a further extension of knowledge. The contributions cover a very wide field, deal with colloidal theory in all its phases, and discuss the methods of applying it in various physical and chemical operations.

Although the work is a collection of papers each complete in itself, there is nevertheless a distinct continuity in the arrangement, which enables the reader to gain a knowledge of the whole sphere of colloidal chemistry in a systematic manner.

Volumes II and III of the work, which are to deal with colloidal chemistry in its relation to (*a*) biology and medicine and (*b*) technology, will be awaited with much interest.

DIZIONARIO DI MERCEOLOGIA E DI CHIMICA APPLICATA. By Prof. Dr. G. Vittorio Villavecchia in collaboration with Professors Dr. G. Fabris, Dr. G. Rossi, Dr. A. Bianchi and Dr. R. Belasio. 4th Edition. Volume IV, Senapa-Zucchero, ed Indice Generale Alfabetico. Pp. 597, 8vo, 10 × 7. (Milan: Ulrico Hoepli, 1926.) Price L.50.

Attention was drawn to this valuable work of reference in this BULLETIN (1923, **21**, 561) on the appearance of the first volume of the new (fourth) edition.

The revised encyclopædia has now been completed with the issue of Vol. IV and a full index to the whole work.

BOOKS RECEIVED FOR NOTICE

Cotton and its Production. By W. H. Johnson. Pp. xxv + 536, 9 × 6. (London: Macmillan & Co., Ltd., 1926.) Price 30*s*. net.

Citrus Diseases and Their Control. By Howard S. Fawcett, with Sections on Oriental Citrus Diseases by H. Atherton Lee. Pp. xii + 582, 9¼ × 6¼. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 25*s*.

Synthetic Rubber. By S. P. Schotz, D.Sc. Tech. (Zurich), B.Sc. (Honours, London), A.R.T.C. (Glasgow), F.I.C. Pp. 144, 10 × 7½. (London: Ernest Benn, Ltd., 1926.) Price 21*s*.

Gum Arabic with Special Reference to Its Production in the Sudan. By H. O. Blunt, M.A. Pp. 45, 11 × 7½. (Oxford: University Press; London: Humphrey Milford, 1926.) Price 10*s*. 6*d*.

Plant Nutrition and Crop Production. By E. J. Russell. Pp. ix + 115, 9 × 6. (Berkeley, California: University of California Press; London: Cambridge University Press, 1926.) Price 12*s*. 6*d*.

Chemistry of the Proteins and its Economic Applications. By Dorothy Jordan Lloyd, M.A. (Cantab.), D.Sc. (Lond.), F.I.C. Pp. xii + 279, 8 × 5½. (London: J. & A. Churchill, 1926). Price 10*s*. 6*d*. net.

The Leather Trades' Year Book, 1926. Edited by Dr. J. Gordon Parker on behalf of the Joint Standing Committee of the United Tanners' Federation and the Federation of Curriers, Light Leather Tanners and Dressers, Inc. Pp. 122 + xlvi, 9 × 6.

Java and Sumatra. By William H. Ukers, M.A. Pp. 61, 10 × 7. (New York: The Tea & Coffee Trade Journal Co., 1926.) Price 25 cents. [A fully illustrated account of the tea industry of Java and Sumatra, with notes on methods of tea cultivation and manufacture.]

Settling in South Africa. By Admiral Sir William H. Henderson, K.B.E. Pp. 36, 9¾ × 6¼. (London: Chas. Knight & Co. Ltd., 227–239 Tooley Street, S.E.1, 1926.) Price 6*d*. post paid. [A useful pamphlet, containing the author's experiences on various farms visited during a tour in South Africa, particularly in the Sundays River Valley. Detailed estimates, supplied by settlers, are given of cost, capital required and profits on farms devoted to live-stock and citrus growing.]

THE TRADE, INDUSTRIES, PRODUCTS, ETC., OF SOUTH AFRICA AND ADJACENT TERRITORIES. A BUSINESS AND GENERAL HANDBOOK. Compiled from Official Sources by C. W. Francis Harrison, F.S.S., F.R.G.S. Pp. 550, $9\frac{1}{2} \times 7\frac{1}{2}$. (Pietermaritzburg: The Natal Witness, Ltd., 1926.) Price 21*s*.

THE COTTON-GROWING COUNTRIES PRESENT AND POTENTIAL. Production, Trade, Consumption. Pp. xxxvi + 317, $9\frac{1}{2} \times 6\frac{3}{4}$. (Rome: International Institute of Agriculture; London: P. S. King & Son, Ltd., 1926.) Price 12*s*. 6*d*.

CONTENTS

VOL. XXIV. NO. 8

PART B—MINERAL RESOURCES

PART B—MINERAL RESOURCES

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Colonial and Indian Governments

---

BRICK, TILE AND POTTERY CLAYS FROM NIGERIA

In previous issues of this Bulletin details have been given concerning technical trials carried out at the Imperial Institute with clays for making bricks, tiles and drainpipes from many parts of the Empire, including Kenya (1921, **19**, 303); Uganda (1921, **19**, 297); Nigeria (1922, **20**, 302); Mauritius (1923, **21**, 587); and Nyasaland (1925, **23**, 281).

The present report deals with technical trials carried out in the ceramic laboratory of the Imperial Institute on four clays from Nigeria.

These clays were sent in 1925 to the Imperial Institute by the Geological Survey of Nigeria in order that their suitability for the manufacture of bricks, roofing tiles, pottery and refractory ware might be fully investigated by means of technical trials and chemical analyses, as preliminary tests, on smaller samples from the same locality, had given promising results, details of which are given in Bulletin No. 8, referred to below.

The geological features of the locality from which the clays were obtained have been described by R. C. Wilson and A. D. N. Bain in *The Geology of the Eastern Railway* (Geological Survey of Nigeria, Bull. 8, 1925, pp. 79–88).

The group of beds from which these samples were taken crop out near Umu Ahia, a station on the Eastern Railway line, about 70 miles from Port Harcourt. They

consist of alternating beds of lignite (see this BULLETIN, 1925, **23**, 202), and greyish-white, gritty and mottled clays. The beds of the latter vary in thickness up to about 26 ft.

DESCRIPTION OF SAMPLES

The four samples of clay received were as follows:

Dark Clay from Obanenu River.—This consisted of a dark-coloured clay containing a large amount of carbonaceous matter.

White Clay from Obanenu River.—This consisted of a pinkish white clay.

Grey Clay from Obanenu River.—The sample consisted of a light-greyish clay much resembling the white clay in physical properties, but containing occasional particles of ferruginous matter.

Clay from Oyivo River.—This consisted of a grey clay mottled with pink.

All four clays became plastic when mixed with water.

RESULTS OF EXAMINATION

The four samples of clay, which were all in a very moist condition when received, were first broken into small pieces and air-dried for about four weeks.

The air-dried clays were next roughly ground so as to pass a sieve having 20 meshes per linear inch, in order to obtain average samples for use in the technical trials described below.

Bricks and Tiles

Although each of the four clays formed a plastic mass with water, only in the case of the dark-coloured clay from Obanenu River was a tendency to stickiness shown. All the clays worked well without any preliminary weathering.

Dark Clay.—Test pieces moulded from this clay cracked and warped very badly when fired at about 1,100° C. and further trials showed that the manufacture of bricks or tiles from the raw clay would not be commercially successful. With a view to overcoming the above defects, further trials were made, using a mixture of 80 per cent. of the raw clay with 20 per cent. of "grog"

(ground burnt clay). Bricks made from this mixture and carefully fired at 1,100° C. showed less cracking, but considerable warpage had still taken place. The linear shrinkage was still very high, amounting to 17·5 per cent.

It is evident, therefore, that this clay is not adapted for the manufacture of bricks or tiles, whether used alone or mixed with "grog." Some improvement might possibly be effected by preheating the clay before moulding, but this would not appear to be worth while in view of the occurrence in the locality of other clays well suited to brickmaking (see below).

White and Grey Clays from River Obanenu and the Mottled Clay from River Oyivo.—Preliminary trials having given promising results, a number of bricks and tiles were moulded from each of these clays in a hand-power screw-press by the stiff-plastic process. During the operation of moulding it was observed that a slight tendency to stick to the moulds was shown by the white and River Oyivo clays, but this was overcome by suitable lubrication of the moulds and die. With this exception the behaviour of all these clays during moulding was very satisfactory.

As the result of experimental burnings it was found that the most satisfactory temperature for burning the bricks was about 1,100° C. This temperature is somewhat above that usually employed for firing building bricks, but it should not give rise to serious difficulties if efficient kilns are used. The bricks and tiles, after being air-dried and then burnt in a gas-fired kiln at this temperature, were next submitted to physical tests, the results of which are shown in the table on the next page.

The above results show that the three clays are suitable for the manufacture of building bricks and ordinary roofing tiles.

It will be noticed that the bricks and tiles produced were whitish in appearance; and should this feature be considered objectionable, it could be modified by coating the articles with a coloured wash before firing.

The transverse breaking strength of the tiles produced is somewhat below the average for the best quality roofing

—	White Clay from R. Obanenu.	Grey Clay from R. Obanenu.	Clay from R. Oyivo.
Water of formation	26·0 per cent.	24·5 per cent.	22·7 per cent.
Maximum firing temperature	1,100° C.	1,100° C.	1,100° C.
Duration of firing at maximum temperature	6 hours	6 hours	6 hours
Shrinkage on drying	4·5 per cent.	3·8 per cent.	3·3 per cent.
Shrinkage on firing	6·9 per cent.	5·5 per cent.	3·5 per cent.
Total shrinkage	11·4 per cent.	9·3 per cent.	6·8 per cent.
Transverse breaking stress (unfired) [2]	209 lb. per sq. in.	210 lb. per sq. in.	181 lb. per sq. in.
Transverse breaking stress (fired) [2]	1,332 lb. per sq. in.	1,529 lb. per sq. in.	1,426 lb. per sq. in.
Porosity (volume of pores expressed as percentage volume of the whole piece)	26·0 per cent.	30·5 per cent.	31·79 per cent.
Water absorption	13·9 per cent.	16·2 per cent.	17·33 per cent.
Warpage on firing (deflection of 6″ tile)	0·03 in.	nil	nil
Cracking strength (fired) [1]	5,517 lb. per sq. in.	5,607 lb. per sq. in.	4,536 lb. per sq. in.
Crushing strength (fired) [1]	9,895 lb. per sq. in.	8,033 lb. per sq. in.	7,953 lb. per sq. in.
Apparent specific gravity (fired)	1·82	1·83	1·86
Weight per cubic foot (fired)	114 lb.	114 lb.	116 lb.
Colour (fired)	Creamy-white	Creamy-white	Pinkish-white
Ring	Good	Good	Good
Softening point of clay (cone test)	Above 1,610° C.	Above 1,610° C.	Above 1,610° C.

[1] *Bricks crushed face downwards, the results being the mean of* 6 *tests in each case.*

[2] *Mean of* 10 *tests in each case.*

tiles of the same type, but would doubtless prove sufficient for all local needs.

The strength of the bricks compares well with that of standard-type building bricks, such as "Flettons," which have a crushing strength of about 4,000 lb. per square inch.

In each case the figures for porosity and water absorption are about normal for this class of brick; and although the total shrinkage in the case of the bricks made from the white clay was somewhat above normal, no serious warpage occurred on firing the ware.

The fact that these three clays can be used in the raw

state, and are easily moulded to give good quality bricks without the use of expensive grinding machinery, appears to be one of considerable importance.

Refractory Ware

From the results obtained in the above brickmaking trials, it appeared very unlikely that the dark clay could be readily adapted for use in the manufacture of refractory bricks. Chemical analyses were therefore made only on the white, grey and Oyivo River clays, and the results obtained were as follows:

—		White Clay from R. Obanenu.	Grey Clay from R. Obanenu.	Clay from R. Oyivo.
		per cent.	*per cent.*	*per cent.*
Alumina	Al_2O_3	26·54	22·29	20·29
Ferric oxide	Fe_2O_3	1·38	1·63	1·16
Titanium dioxide	TiO_2	1·21	1·36	1·43
Silica	SiO_2	59·30	64·34	67·98
Lime	CaO	0·11	0·08	0·06
Magnesia	MgO	0·32	0·20	0·32
Potash	K_2O	0·40	0·12	0·10
Soda	Na_2O	0·08	0·06	0·16
Loss on ignition		10·74	9·63	8·41

The above analyses, calculated on a loss-free basis, are shown below in comparison with those of three Stourbridge fire-clays, calculated in a similar manner:

—		White Clay from R. Obanenu.	Stourbridge fire-clay.	Grey Clay from R. Obanenu.	Stourbridge fire-clay.	Clay from R. Oyivo.	Stourbridge fire-clay
		per cent.	*per cent.*	*per cent.*	*per cent.*	*per cent.*	*per cent.*
Alumina	Al_2O_3	29·70	28·02	24·74	23·41	22·17	21·70
Ferric oxide	Fe_2O_3	1·54	1·83	1·81	1·96	1·27	1·39
Titanium dioxide	TiO_2	1·35	1·41	1·51	1·06	1·56	1·43
Silica	SiO_2	66·38	66·64	71·42	71·93	74·29	73·58
Lime	CaO	0·12	0·38	0·09	0·51	0·06	0·34
Magnesia	MgO	0·35	0·55	0·22	0·28	0·35	0·29
Potash	K_2O	0·44	1·13	0·13	0·74	0·10	0·85
Soda	Na_2O	0·09	0·04	0·06	0·11	0·17	0·41
Total		99·97	100·00	99·98	100·00	99·97	99·99
Loss on ignition		10·74	9·45	9·63	8·10	8·41	7·51

It will be seen that the chemical analyses of the three Nigerian clays approximate very closely to those of

typical English Stourbridge clays, but contain somewhat lower percentages of alkalis.

In view of this resemblance, technical trials were carried out at the Imperial Institute in order to determine whether refractory bricks of good quality could be made from these three Nigerian clays.

Fusion cone tests showed that in each case vitrification without softening took place at about 1,610° C. In order to ascertain whether any softening or deformation was likely to occur when heated under a small load, bricks made from these clays were fired, supported at the ends only, at a temperature of about 1,610° C. for one hour. It was found that the white and River Oyivo clays showed no signs of sagging, but that the grey clay bent and cracked under its own weight.

It should be noted that it is not usual to employ highly plastic raw clays alone for fire-brick manufacture, but to add some coarse inert material, such as ground burnt clay (grog), in order to reduce the plasticity and render the fire-bricks more durable. This process, of course, adds to the cost of the bricks, but is in accordance with commercial practice.

The results of the technical trials carried out at the Imperial Institute indicate that the white and River Oyivo clays would be suitable for the manufacture of second-grade refractory bricks, according to the specification for fireclay bricks of the Institution of Gas Engineers (1911, revised 1922), and that the grey clay, though inferior to these, also possesses refractory properties which place it in the same grade.

Pottery

Dark Clay from River Obanenu.—No tests were made with this clay as its high shrinkage on firing would render it unsuitable for the production of pottery.

White and Grey Clays from River Obanenu and River Oyivo Clay.—These three clays, which were free from coarse grit, worked well on the wheel and could also be easily pressed in plaster moulds.

Vessels made from the raw clays, when fired at a temperature of 1,100° C., gave a fairly strong porous

ware, which would be suitable for covering with either opaque or transparent glaze.

The biscuit produced from the white clay was superior in colour to that yielded by the grey and River Oyivo clays. The total shrinkage of this clay was, however, rather high. This shrinkage could be reduced by the addition of ground flint or quartz to the raw clay, but if this were done it would be advisable to add also a certain amount of finely ground felspar in order to increase the strength of the fired body.

The grey clay yielded a biscuit somewhat disfigured by spots caused by the presence of small particles of ferruginous matter, but these could be obscured if necessary by an opaque glaze.

The River Oyivo clay had a low shrinkage, but the colour of the biscuit was not quite so good as that given by the white clay. This, however, is of little importance, as the ware would necessarily be covered, in most cases, with opaque or coloured glazes.

It is interesting to note that although these three clays contain low percentages of fluxes, when fired to a temperature of 1,100° C. they attain a considerable degree of strength, which renders them suitable for the production of pottery for local domestic use. If stronger and more durable ware should be required it could be made by the addition of suitable small amounts of materials such as finely ground felspar or chalk to the raw clay.

The clays could also be used for the manufacture of fine earthenware if mixed with suitable proportions of felspar, flint, and possibly also a less plastic white clay.

Summary and Conclusions

The results of the trials carried out at the Imperial Institute on these four clays may be summarised as follows:

Bricks and Tiles.—Strong white building bricks and tiles can be made without difficulty either by hand or mechanically from the white or grey clays from the Obanenu River or the clay from River Oyivo. No preliminary treatment would be required, and the addition of "grog" would not be necessary. It may be remarked

that as regards ease of working and strength of the finished product, these three clays are the most promising Nigerian clays that have hitherto been submitted to brick-making trials at the Imperial Institute.

The dark clay from Obanenu River would be difficult to work commercially, and for that reason its use is not recommended.

Refractory Ware.—The white and River Oyivo clays would be suitable for making second-grade refractory bricks. It is possible that the grey clay might be utilised for refractory purposes, but the technical trials indicated that it would prove inferior to either the white or River Oyivo clays for this purpose. The dark clay would be quite unsuitable.

Pottery.—Working trials on the white, grey and River Oyivo clays showed that all were suitable for the making of pottery ware either on the potter's wheel or by moulding.

The biscuit produced by firing the ware was in each case strong, that yielded by the white clay having the best appearance. The biscuit could be glazed if so desired.

The clays could also be used in the production of fine earthenware.

The specimens of ware produced in the course of this investigation are available for inspection at the Imperial Institute.

ARTICLE

THE MINERAL INDUSTRY OF THE UNION OF SOUTH AFRICA

GENERAL

THE extensive territories of the present Union of South Africa were, until about fifty years ago, occupied by a very small pastoral population, and little or nothing was known of their mineral resources.

The discovery of diamonds in 1867, and later on of the famous diamond deposits of the Kimberley district in 1872, caused a flow of population and of capital into the country, and its development began. The finding of gold afterwards in different parts of the Transvaal

was followed by the discovery in 1886 of the famous Witwatersrand auriferous conglomerates (commonly known as the Rand banket), and since that time the diamond and gold industries have each assumed and maintained prime importance in the world's production of these minerals.

Almost concurrently with the discovery of gold on the Rand, immense deposits of coal were found, and within the last few years it has been shown that in South Africa there are considerable resources of iron ore.

The importance of these discoveries has done much to induce the belief that South Africa might at any time disclose other remarkable mineral resources, and, as if to confirm this belief, there have been found recently in the Transvaal large deposits of platinum ore, such as have never been known before, from which it is anticipated that the output of platinum will eventually exceed that of the rest of the world.

Extensive deposits of manganese ore have been found recently in Cape Province, and for the development of these capital has already been found. There are also in the Union important deposits of other base metals, including tin, lead and copper, and of many non-metallic minerals, notable among which are deposits of asbestos, mica and corundum.

The growth of mineral production as a whole has been very great; even since the passing of the Act of Union, in 1909, the total annual value has increased from £42,880,177 in 1910 to £54,251,976 in 1925.

The following figures in ten-year periods show the growth of output for the three most important minerals:

Period.	Gold. (fine oz.)	Diamonds. (metric carats).	Coal. (long tons).
1886–1895 . .	7,847,019	32,439,000[1]	(not available)
1896–1905 . .	26,205,586	30,808,000[1]	23,000,000
1906–1915 . .	77,765,578	43,193,845	62,684,829
1916–1925 . .	86,682,224	21,682,973[2]	98,766,648

[1] *Approximate.* [2] *Restricted output.*

A Departmental Committee reporting on the development of the mineral resources of the Union in 1925 divides them into the following categories:

(*a*) *Those already extensively exploited :* Gold, diamonds, coal, raw material for cement, copper, tin.

(*b*) *Those only partially or intermittently exploited :* Antimony, arsenic, asbestos, chrome iron, clays, corundum, glass sand, lead, manganese, marble, mineral ochre and mineral paints, ornamental stones, phosphates, soda, sulphur (pyrite), talc, vanadium, etc.

(*c*) *Those available in large quantities, but not yet exploited at all :* Iron ore, oil shale.

(*d*) *Deposits of minerals not yet discovered or found in negligible quantities only :* Silver, mercury, tungsten, etc.

Since the publication of the report a few important changes have been made in the situation, and these will be referred to below.

Much information on the mineral resources of the Union is published in the reports of the Minister of Mines and Industries, the Secretary of Mines, the Government Mining Engineer, the Geological Survey, and the Chamber of Mines and in the transactions of the geological and other scientific societies of South Africa, which have been consulted in the compilation of this article.

Gold

The output from gold-mining in the Dominion of South Africa amounts in value to about four-fifths of the total mineral production. Its magnitude will be realised from the fact that to the end of 1925 the value of the gold won in the Transvaal was about £884 millions. At the present time the Witwatersrand is producing about 97½ per cent. of the total output. This gold-mining area stretches from Randfontein in the west to Springs in the east, a distance of about 80 miles, Johannesburg being roughly in the centre. This city has grown to be by far the largest mining town in the world, covering an area of 26½ square miles and containing a population of 160,000 Europeans and 130,000 natives.

The auriferous deposits are part of a series of beds of conglomerate, probably of pre-Cambrian age, which are roughly parallel to one another and are usually alluded to as reefs. The auriferous conglomerate or " banket " consists of quartz pebbles in a quartzitic matrix containing

auriferous pyrite. In the Central Rand, the beds which form the profitable source of the gold are known as the *Main Reef Series*, and consist of three separate beds of conglomerate: (1) the *Main Reef*, the most northerly and lowest member of the group, averaging about 4 ft. in thickness and of constant low grade; (2) the *Main Reef Leader*, which is next, on the average about 15 in. in thickness, but of higher grade, and (3) the *South Reef*, averaging about 3 ft. in thickness. These reefs show considerable variations. The Leader disappears in the West Rand, while it is the only surviving member in the Far East Rand, where it is known as the Van Ryn Reef, and farther to the south-east, as the Nigel Reef.

During their early stages, mining operations on the Rand were confined to the neighbourhood of the outcrops, but at the present time they are carried on at greater depth than anywhere else in the world with the exception of the Morro Velho mine in Brazil; on the Village Deep mine, for example, development has nearly reached a projected depth of 7,000 ft. vertical or over 1¼ miles, while stoping is being carried on between depths of 3,800 and 5,800 ft. The neighbouring City Deep mine is being developed to a depth of 6,900 ft. vertical.

As an example of a highly profitable mine, the Government Gold-Mining Areas mine in the East Rand might be mentioned. Although closely followed in importance by the Hollinger mines in Northern Ontario, it is the most important gold mine in the world; in 1925, from 1,932,000 short tons crushed, 861,989 oz. of fine gold were recovered. The total working revenue was £3,706,682, and working expenses £1,618,373, the working profit being £2,088,309. The ore reserves at the last published estimate were 11,355,000 tons of 9·0 dwt. ore.

On the Rand generally, the grade of the ore treated varies between 11 and a little over 4 dwt. of fine gold per ton. The average is a little over 6½ dwt. In 1925, there was an output of 9,346,697 oz. from 28,303,108 short tons of ore at a cost of £27,082,010. Dividends paid amounted to £8,157,917. In 1924 the Government received in direct revenue from the mines £5,182,782. This amount included royalties, which are the Govern-

ment's share in the profits of certain mines owned by the Government, calculated in each case according to a special formula. In the case of the Government Gold-Mining Areas mine, in 1924, the Government's share of the profits amounted to £1,311,290, while the company had paid a total of £6,010,261 to that date. Operations were commenced in 1914 with heavy losses.

It has been calculated that the gold industry supports indirectly about a quarter of a million white and one million native people.

All mining and metallurgical operations are conducted on a gigantic scale, with the aid of the best machinery and the use of the most up-to-date methods of mining and metallurgy. The total mining development on the Rand since 1887 amounts to about 3,500 miles, and is increasing at the rate of 16 miles per month. Electric power and compressed air supplied by various stations of the Victoria Falls Power Company are largely used. The low cost of mining is due to cheap unskilled native labour, to cheap coal mined in the neighbourhood, to the uniformity of the reefs, and to the small amount of water to be pumped.

The gold produced varies in fineness from 850 to 920 parts per 1,000. It is all refined at Germiston, near Johannesburg, where there is the largest gold refinery in the world. The refined gold is about 995·5 fine.

Efforts are continually being made to reduce working costs, not only to increase profits, but also to include lower grade ore in the ore reserves, and thus extend the life of the goldfield. For the purpose of economy in administration, the 43 mines now in operation on the Rand are grouped under the control of a number of large mining "houses." These groups are in turn represented in the Transvaal Chamber of Mines, which looks after the interests of the industry generally.

Gold mining is carried on elsewhere in the Transvaal, on a scale relatively small compared with that on the Rand, in the neighbourhoods of Pilgrim's Rest, Barberton, Heidelberg, Klerksdorp, Ottoshoop, Pretoria and Pietersburg. In these areas, at the beginning of 1926, some 20 mines of notable size were in operation, 9 being near Pilgrim's Rest and 6 near Barberton. In addition to

these there were about 20 small mines and 6 tailings plants; also a few alluvial diggers.

The Pilgrim's Rest goldfield and the Sabie district, a little to the south, produce gold of about £450,000 in value per annum from a number of horizontal reefs in dolomite and quartzites. The Barberton mines, some dating from 1884, produce from quartz reefs gold to the value of about £200,000 per annum.

The gold-mining industry has apparently reached a period of maximum production, and gradually decreasing outputs may be expected; but, as mentioned above, a further reduction of working costs would do much to extend the life of the Rand. A similar effect would be produced by new discoveries that are possible in the south-east of the Springs district in the Far East Rand and in other places.

Silver

A large amount of silver is recovered from gold bullion produced in the Transvaal, the total amount in 1925 amounting to 934,254 fine oz., valued at £134,454. In addition, 225,815 oz. of silver of value £32,388 was won in base metal, principally from lead ores.

Platinum Metals

Osmiridium has been known for many years to occur in small quantities as a constituent of the Rand banket, but for some time no attempts were made to recover it. It is found in greater amount in some mines of the East Rand, and the recent introduction there of corduroy tables at the ends of the milling plants has resulted in the recovery of a considerable amount of osmiridium, and the Transvaal now is by far the largest world producer of this metal. In 1925 the output of 6,055 oz. was valued at £170,995.

For a long time past mining operations have been carried on intermittently at Insizwa in Cape Province, where there is a large basin-shaped mass of norite rocks. At the basal margin of these rocks are copper and nickel sulphides containing gold, silver and platinum metals. So far the operations have not been profitable.

Within the last few years platinum has been found

among the basic rocks of the Bushveld Igneous Complex, a basin-shaped accumulation of igneous rocks, including granites and various basic rocks, notably norites. This Complex is roughly oval in shape; it is about 250 miles long, east to west, and about 125 miles wide. The centre of its southern boundary is just north of Pretoria.

Platinum metals have been known for some time to be present in small quantity in the rocks of this Complex, but only since 1923 have they been found in notable amount. In that year two lodes of platiniferous quartzose ore traversing felsites were found in the Waterberg district. The platinum is distributed very irregularly through the ore, and as some of it is of almost colloidal fineness, its recovery has proved very difficult. From 3,785 short tons of ore treated in a pilot plant in the months April to July, 1926, a recovery of only 2 dwt. of crude platinum per ton was made. Operations were suspended at the beginning of September. In 1924, much attention was attracted to discoveries of platinum in the norite zone of the Lydenburg district, and active exploration over a large area was begun by a number of companies. Because of the high-grade nature of some small pipes of hortonolite-dunite (an olivine rock), prospecting operations were largely confined at first to the examination of similar occurrences, and although many were tested, only the three pipes originally found on the farms Onverwacht, Mooihoek and Maandagshoek were proved to be of any value. The pipe on Onverwacht is the smallest, but the richest, of the three. On it a small experimental plant has been in operation since the middle of January, 1926, treating recently over 1,300 tons of ore per month for an average recovery of 10 dwt. of crude platinum per ton. The platinum is being refined in England, and the first results published gave £18 4*s.* 3*d.* per oz. after paying expenses. The plant is being increased to a capacity of 2,500 tons per month, and sinking to 350 ft. depth is in progress.

The most important platiniferous zone found hitherto in the Lydenburg district is the Main Lode or "Merensky Reef," so named after its discoverer. It consists of a segregated sheet of bronzitite in norite, and has been

traced at intervals for over 80 miles, maintaining the same characteristics throughout. The lode, from 6 to 30 ft. thick, has a pay-streak from 3 to 5 ft. thick. The platinum is associated in depth with pyrrhotite, pentlandite and chalcopyrite.

Approximately parallel to the main lode, especially in the northern part of the field, are chromite ore-bodies in which are pay-streaks, some over 2 ft. thick, with high platinum contents.

Similar geological conditions exist in the Potgietersrust platinum field to the north-west of the Lydenburg field, where the Merensky Reef has been traced in a north-west direction at intervals for over 25 miles. Already some deposits of large size have been opened up, and a treatment plant with a capacity of 3,000 tons of ore per month is approaching completion.

In the more recently found deposits of the Rustenburg district, to the north of Pretoria, the geological conditions largely correspond with those of Lydenburg. The Merensky Reef has been traced with some breaks for a distance of over 100 miles, and the richness of its platinum-bearing portions bears favourable comparison with the attractive portions of the Lydenburg and Potgietersrust fields.

Although much development work has been carried out, and results from the treatment of the various kinds of ores have been obtained on a small scale, it is not yet possible to say what the output of platinum in the Transvaal will ultimately be; but there is every indication that, if the metallurgical difficulties can be overcome, it will be of considerable magnitude.

A large amount of information on the platinum deposits is to be found in the following articles, amongst others:

"Notes on the Platinum Deposits of the Bushveld Igneous Complex," by P. A. Wagner (*Trans. Geol. Soc. S. Africa*, 1925, **28**, 83).

"The Bushveld Igneous Complex," by A. L. Hall (*Journ. Chem. Met. and Min. Soc. S. Africa*, Jan. 1926. p. 160).

Diamonds

From its immense resources, South Africa has been described as the home of diamonds. The diamond in-

dustry of the Union began in 1867, the total output of that year and 1868 being only 200 carats. This was greatly increased in the succeeding years, and in 1872, when diamonds were found in the neighbourhood of Kimberley, the production reached over one million carats. Up to the end of 1925, 153 million carats had been recovered, or over 30 long tons, worth over £244 millions. The diamond industry in the Union, although carried on under restricted conditions, is second only to that of the gold, and with that of South-West Africa provides nearly three-quarters of the world's demands. It has been estimated that South Africa could supply the world for the next 100 years at least.

Diamonds have been found over a large area stretching from the Limpopo River in the north to Victoria West in Cape Province, but nearly all the deposits of any value are found in a belt of country extending in a north-east direction from Fauresmith in Orange Free State on the south side to beyond Pretoria in the Transvaal, a distance of 350 miles, its width being about 150 miles measured in a north-westerly direction.

Diamonds are found in two classes of deposits, viz. (1) as pipes, in which the diamonds are always associated with a special rock matrix known as kimberlite, and (2) in alluvial deposits. Kimberlite, a brecciated peridotite rock containing biotite, is always the material looked for when prospecting for diamonds. The pipes are deeply eroded, funnel-shaped volcanic necks, and are usually connected at some depth with dykes filled with the same rock material. Out of some 150 pipes found in the belt of country mentioned above, only 7 per cent. proved to be sufficiently profitable to work.

The most important pipes so far known are the Kimberley, De Beers, Bultfontein, Dutoitspan and Wesselton, near Kimberley, Cape Province; the Jagersfontein and Koffiefontein in the Orange Free State; and the Premier, east of Pretoria.

The diamantiferous material in the upper part of a pipe, known as yellow ground from its colour, arises from the oxidation of blue ground, below which is found the unaltered kimberlite, from which the blue ground is

formed by hydration. The mined material is crushed and pulverised in water ; the pulp is roughly concentrated, and the concentrate is passed over inclined shaking "grease" tables covered with petroleum jelly, to which the diamonds become attached, together with garnets and other inferior material. The diamonds are separated, and, after being cleaned with petrol and hydrofluoric acid, are valued by experts.

Alluvial diamonds are found in stream gravels of Tertiary and Recent ages, principally in the basins of the Vaal, Harts and Orange rivers. Diamond digging commenced near the junction of the Orange and Vaal rivers in Cape Province, and is now carried on over a large area extending east and north into the Western Transvaal. Along the Vaal River, operations are conducted near Christiana, Bloemhof, Wolmaransstad, Klerksdorp, and even in places so far remote as Parys and Vereeniging. Alluvial ground has been found at Kameelfontein, near the Premier mine. Fresh discoveries are frequently made, and it is likely that many patches of diamantiferous ground will yet be found in the large area between Vereeniging and Barkly West.

An alluvial field which has been recently discovered is being proved along the west coast of Cape Province to the south of Port Nolloth ; it extends for 100 miles along the coast in sand dune country. The diamonds are found at shallow depth in gravel. The well-known diamantiferous coastal deposits of South-West Africa extend northwards from a point about 140 miles north from Port Nolloth.

Alluvial diamonds are of much greater value than those recovered from pipes. In the three diamond-producing provinces, Transvaal, Cape Province and Orange Free State, the mine stones won in 1925 were worth, on an average, 31, 74 and 65 shillings per carat respectively, whilst the alluvial stones in those provinces were valued at 148, 176 and 148 shillings per carat.

The total output of diamonds in the Union in 1925 was 2,430,128 carats, worth £8,198,128. Roughly nine-tenths of the diamonds were mine stones. Of the total weight of diamonds recovered in the Union, Cape Province

produced 52, Transvaal 37, and Orange Free State 11 per cent.

To maintain the stability of the diamond industry, almost the total output of the world is controlled by the Diamond Syndicate, an association of sellers, which regulates the supply of diamonds according to demands, allotting a proportion to each big producer. The four leading producing companies in Southern Africa have the following percentages allotted to them according to an agreement recently made, which comes into force in 1927: De Beers, 51; Premier, 18; New Jagersfontein, 10, and Consolidated South-West Africa, 21. [The mandated territory of South-West Africa is not dealt with in this article.] The Syndicate deals in rough stones only, which it sells through its recognised brokers to merchants in Amsterdam and Antwerp, where the stones are cut and polished. A small amount of diamond-cutting has been carried on at Pretoria and Johannesburg, but the output is negligible.

Coal

Without a cheap and abundant supply of coal the great gold and diamond industries could not have been carried on. The coal industry not only supplies the wants of the mines, railways, the various growing industries of the Union, and bunkering requirements at the ports, but also feeds a considerable and growing export trade, coal being shipped to South America, Mauritius, Madagascar and India. All coal exported is graded according to Government regulations.

The amount of coal sold in the Union in 1925 was 11,613,519 long tons, valued at £3,880,442 at the pit's mouth. This amount of coal bears but a very small ratio to the known coal reserves, which Sir Robert Kotzé in 1911 estimated at 36,000 million tons in the Transvaal and 9,400 million tons in Natal. Discoveries of coal made since 1911 have materially added to these figures. At the present time coal is being produced at the collieries in the Transvaal for a little over 5*s.* 6*d.* per long ton, and in Natal for under 8*s.* 6*d.* per ton. This low cost is due to the number of the competing collieries, which

are well equipped, cheap native labour, the size of the coal seams, and other natural advantages.

Of the total output of coal of the Union in 1924, about 55 per cent. was mined by 30 collieries in the Transvaal and 37 per cent. by 28 collieries in Natal; three collieries in the Orange Free State produced about 7 per cent., while there was a small production in Cape Province.

All the coal deposits of South Africa are found in its eastern part, nearly all the coal measures lying in the Middle Ecca sandstones (Permian). These have been estimated to cover about 44,000 sq. miles, of which possibly one-half may ultimately be proved coal-bearing. Peculiar to Cape Province are the Molteno Beds of the Stormberg Series. The coals of this province are only mined for local use and are of poor quality.

The coal produced in Natal is comparatively good, varying in calorific value from 13,300 to 14,700 B.Th.U. Coal is being produced over an area of 2,000 sq. miles, principally in the Klip River, Newcastle, Utrecht and Vryheid districts. As with other coal-producing areas in the Union, not enough boring has been done to render possible an accurate estimate of the reserves. In one colliery—Dewar's Anthracite—only anthracite is produced.

In the Transvaal, coal measures continuous with those in Natal from the south-east are found in what is known as the High Veld area. They extend as far north as the centre of the Middelburg district, and as far west as Brakpan, and cover an area of between 9,000 and 10,000 sq. miles. This is the only area in the Transvaal where coal mining is carried on. The collieries are nearly all in the Boksburg, Middelburg and Ermelo districts. The Transvaal coals, as mined, vary in calorific value from 10,200 to 12,700 B.Th.U., those of the Middelburg field being the most consistent in quality.

Coal measures covering 750 sq. miles in the Bushveld area, 30 miles north of Pretoria, have been proved by boreholes to overlie coal about 10 ft. thick, but of inferior quality. A narrow strip of coal measures about 6 miles wide and running for about 400 miles north and south near and parallel to the Portuguese border, and known as the Lebombo area, carries coal of average quality,

but some is anthracitic. In the Limpopo area of 2,000 sq. miles, stretching west along the Limpopo Valley in Northern Transvaal, a 36-in. seam of inferior coal is known. An extension of the Limpopo coal was found in the North Waterberg district in 1921 when boring in search for water. Eight seams were found, the lowest two being of good average quality, the others being very bituminous and of better coking quality than any other in South Africa.

In the Orange Free State the coal measures cover a large area, the actual extent of which has not yet been determined.

The coal produced, principally at Clydesdale and Vierfontein near Vereeniging, to the south and south-west respectively, is of second quality, but is useful for steaming and domestic purposes.

Coke, of excellent quality for foundry purposes, and various by-products, are produced in Natal by the Dundee Coal Co., in amount sufficient to supply all the wants of the Union.

Calcium carbide is produced at the Ballengeich Colliery, while the Natal Ammonium Co. produces a considerable amount of ammonium sulphate.

The coal resources of the Union are fully described by W. J. Wybergh in "The Coal Resources of the Union of South Africa," Vols. 1 and 2, being *Memoir* 19 of the *Geological Survey, Union of South Africa.*

Iron

In view of the large reserves of coal and iron ores existing in the Union, and the growing demand for iron and steel, the question of iron and steel production has received much consideration. For some time past at Vereeniging in the Transvaal a large plant has been producing steel from scrap material, and at Newcastle in Natal a blast-furnace plant has been erected lately for producing pig-iron. A recent amalgamation of these interests has resulted in the formation of the Union Steel Corporation, which has already begun operations and aims at ultimately supplying all the internal needs of Southern Africa, including Rhodesia. Most of the pig

iron produced at Newcastle will be converted into steel at the Vereeniging plant, which has a capacity of 60,000 tons of ingots a year. At the present time the Corporation is drawing ore from its Prestwick mine near Dundee, where reserves of ore are estimated to be sufficient for at least 10 years. The deposit consists of hæmatite and is interbedded with sandstones of Karroo age. The Corporation also controls a deposit of hæmatite ore of large size in the Kroondraai property, which will be developed later. The ore on this property contains on an average 56 per cent. of iron and about 12½ per cent. of silica, and is low in phosphorus and sulphur. The deposit is in the Warmbaths district of the Transvaal, and is one of a series of similar extensive deposits in disturbed rocks at the edge of the Bushveld granite. It will be reached by a railway extension of 27 miles from Pienaars Station on the Messina Railway.

Although the iron-ore resources of the Union are considerable, they are as yet but little developed. Large quantities of titaniferous iron-ores and of chrome iron-ores along the margin of the Bushveld, and extensive beds of siliceous iron-ores in the Transvaal System, especially in the Pretoria district, are not workable under present conditions. Other important iron-ore deposits occur in the Ermelo and Potchefstroom districts, at Buffelshoek and Crocodile River in the Rustenburg district, and at Airlie near Belfast.

There is an abundance of all classes of fluxes required in the iron and steel industries, while all the coke likely to be wanted can be easily produced.

Asbestos

The large number, variety and great extent of the asbestos deposits of the Union are becoming well known throughout the commercial world, and the output of asbestos is rapidly increasing. In 1925, it was 9,078 long tons, valued at £152,115. The varieties, all of which are mined on a considerable scale, include crocidolite or Cape blue asbestos, amosite (which is not known to occur elsewhere), and chrysotile or serpentine asbestos.

Crocidolite differs from chrysotile in having a lower

resistance to heat, but it is claimed that crocidolite, as compared with chrysotile, has a greater insulating efficiency with regard to heat and electricity, that it is unaffected by ordinary acids and by sea-water, and that its fibres are stronger and more elastic. Its qualities are becoming more fully appreciated, and production, especially of the better grades, is at present not keeping pace with the demands.

Crocidolite is found in banded ironstones of the Lower Griquatown Series in the northern part of Cape Province in a belt of country about 250 miles long from north to south and up to 30 miles wide, extending from the Mashowing River in British Bechuanaland to a point near Prieska, south of the Orange River. The principal mining centres are Keikamspoort, near Prieska, Koegas, Westerberg, Danielskuil and Kuruman.

The Cape Asbestos Company, which is the oldest operator in the asbestos area, has its centre of operations at Draghoender, some 35 miles north-west of Prieska, where the workings have been carried to a depth of over 230 ft. vertical. The length of fibre obtained varies from about one-half to one inch. Fully 25 per cent. is about one inch long. In the northern section of the belt there are a number of smaller operators whose more recent workings extend to the north of Tsenin on the Kuruman River.

Crocidolite has also been found in a belt south of Pietersburg in the North-Eastern Transvaal extending east from Chuniespoort to Steelpoort River. Amosite and chrysotile occur in the same belt. Seams of crocidolite are found interbedded in ferruginous slates in the lower part of the Pretoria series of rocks close to underlying dolomite. The fibre is identical with that in Cape Province. The deposits are being slowly but steadily developed.

Amosite, which is grey in colour, resembles crocidolite in composition and owes much of its importance to its unusual length of fibre, which averages about 6 in. It is more resistant to heat than crocidolite, and at least equal to that variety of asbestos in other respects. Carding machinery having been modified successfully to deal with its long and somewhat harsh fibres, amosite is growing in popularity, the best grades for the manufacture of

yarn and cloth, and the lower grades for asbestos-cement slates and corrugated roofing, blocks for boiler insulation, etc.

Amosite is found over a large area in the Northern Transvaal extending for about 60 miles from Chuniespoort to Penge. The district has become more accessible recently by the extension of the railway northwards from Lydenburg to the Steelpoort River. The deposits occur as interbedded veins in highly ferruginous metamorphosed shale in lower members of the Pretoria Series, and are thus essentially similar in character and geological age to the crocidolite deposits of the Lower Griquatown series of the Cape Province. Owing to the nature and regularity of its deposits amosite can be produced much more cheaply than the other asbestos minerals. The chief centres of mining are at Penge, 60 miles north of Lydenburg, and Malips Drift, 45 miles south-east of Pietersburg. The chief producing mines of the former district, the Egnep and the Amosa, are now controlled by the Cape Asbestos Company. The Egnep has been opened up to below 400 ft. and for over 2,500 yds. along the strike. In view of the decreasing supplies of the longest blue asbestos fibres the advent of amosite into the market is very opportune.

Chrysotile is found at several localities in Natal and in the Transvaal, but the most important deposits are at Kaapsche Hoop, near Barberton, where there are three companies actively employed, two in the Western Section, and one in the Eastern Section. The seams of asbestos are associated with a belt of serpentine for over 3 miles. Most work has been done in the Western Section, where there are two distinct fibre horizons. The fibre, which is of excellent quality, is cheaply mined, the recovery being high. Operations are conducted at a depth of over 300 ft. Similar fibre is found in the Eastern Section, where there is only one fibre horizon.

Chrysotile has been occasionally produced from the Sitilo mine in the Tugela Valley between Eshowe and Kranzkop Station, Natal, where it occurs in a series of parallel seams in serpentine. A fibre length of ¼ to 1 in. is obtainable.

Asbestos minerals are known at a number of other places in the Union, and lately deposits of chrysotile between Sabie and Lydenburg, Transvaal, have been described. "The Asbestos Resources of the Union of South Africa," by A. L. Hall (*S. African Journ. Indust.*, Nov. 1924, p. 724), should be consulted for further information.

Chromite

Segregations of chromite have been found for great distances along the margin of the Bushveld area of the Transvaal in pseudo-stratified formations. These are often of workable dimensions. The chromic oxide content is usually from 35 to 40 per cent., but in the North Lydenburg district it reaches as high as 54 per cent.; it is also richer in the Rustenburg district, where about 2,000 tons of ore are produced per month in the neighbourhood of Boschhoek. Chromite is now being mined on the farm Mooihoek, near Fort Burger, Lydenburg district. It is known in a number of other places where, however, it is of low grade. The output of chrome ore in the Union in 1921 was 1,061 long tons. Since then there has been a considerable increase, for in 1925 the sales were 11,137 tons, containing 42 per cent. of chromic oxide, and were valued at £21,001.

Copper

Copper mining has been carried on since 1852 in Namaqualand, in the Western District of Cape Province, in a number of mines, but as these are nearly exhausted, operations have been almost suspended. Copper has been found in a number of other places in Cape Province, including Turnstream in the Cathcart district; at Beaufort West; and at Insizwa in the Mt. Ayliff district, where there is a great mass of intrusive norite containing chalcopyrite and pyrite associated with nickel and some platinum. The massive cupriferous pyrites of the New Areachap mine at Gordonia is used for making acid. Other occurrences of copper ore are known, but few have gone beyond the development stage. The only mines producing at present are those of the Messina (Transvaal) Development Co., Ltd., in the extreme north of the Transvaal,

where in the financial year 1924–25 marketable products containing 5,906 long tons of copper were produced. The total value of the copper reduction of the Union to the end of 1925 was £24,393,758.

Corundum

At the present time South Africa is the world's chief producer of corundum. The most important producing area, covering about 2,000 sq. miles, is in the Zoutpansberg and Pietersburg districts of the Northern Transvaal, especially between Louis Trichardt and Zoekmakaar, and in the Low Country to the east. The mineral occurs on the surface in eluvial form either as " crystal corundum " or massive, known usually as " boulder corundum." It occurs also as " reefs " in contact with igneous rocks. During the late war, when there was a sudden and great demand for abrasives, attention was drawn to the South African corundum. The surface material was collected cheaply by native labour, working on contract, and, after a primitive screening and washing in rotary pans, it was exported. The output reached 500 short tons per month. The crystals, which are of all sizes up to 10 in. long by 5 in. across, are of various colours. They contain up to 97 per cent. of alumina, and are of high abrasive efficiency. Boulder corundum, found in much smaller quantity than the crystal, consists of aggregates of crystals and grains of corundum in a matrix consisting principally of felspar, but containing also biotite, magnetite, etc. The corundum content is 50 to 80 per cent.

After the war, largely owing to competition from the artificial abrasive industries, attention was given in South Africa to the better preparation of the corundum for the market, and one Company in particular, the Transvaal Grain Corundum Co., Ltd., erected a mill to produce 15 different standard grades of grain corundum in sizes between 10 and 100 mesh. The Company mines " reef " corundum on the two adjacent farms, Turkaspost and Bultfontein, near Bandolier Kop, and also treats surface material. The " reef " contains vertical bodies, 12 ft. thick, of coarse white plumasite, which is a felspar-corun-

dum rock resembling boulder corundum in composition; the rest of the reef consists of almost pure felspar. The Company is also working corundum on eleven other farms in the same neighbourhood, but as yet mining operations are conducted at only comparatively shallow depths. There are a few other operators in the district.

In the Low Country, to the south-east of Bandolier Kop, corundum deposits, which are similar to the above, extend in an east-north-east direction from near Mica Siding to Malelane and thence to the Portuguese border, a total distance of about 75 miles. There was some production formerly. Corundum is won on a small scale from surface material in Little Namaqualand, about 4 miles east of Steinkop in a strip of country 4½ miles long by 500 yds. wide.

There are a few other occurrences in South Africa, but they are comparatively unimportant.

The output of corundum in the Union in 1925 was 1,635 long tons, valued at £13,229. The trade is rapidly increasing, the exports for the first four months of 1926, chiefly to the United States, amounting to 1,496 tons, valued at £11,735.

Fluorspar

This mineral is known to occur at various places in the Transvaal dolomite formation, and is being mined on a rapidly increasing scale at two localities, viz. at Ottoshoop, near Zeerust, in the Marico district, and at Mabula, near Warmbaths, in the Waterberg district of the Transvaal, the production at the former locality being at present about 10,000 long tons per year, and at the latter about 1,600 tons. At Ottoshoop the deposits being worked are roughly circular in shape and from 70 to 150 ft. across; but their depth is not yet known as the workings so far are comparatively shallow. Each deposit contains very high grade material, which is of 99·5 per cent. purity with a silica content of less than 0·3 per cent., and so is especially suitable for the manufacture of hydrofluoric acid. A large proportion of the fluorspar, being colourless, includes material suitable for optical purposes; but purple, greenish, yellow and brown-coloured varieties occur.

The remarkable purity of the mineral has already attracted attention abroad, and an important and growing export trade has been developed in the last few years. With the recent establishment of an iron and steel industry in the Union, the internal demands for fluorspar are likely to increase considerably.

LEAD

As is commonly the case in other parts of the world where there is dolomite, there are many lead deposits in the Union which have been found in association with that rock. The deposits known so far occur in Cape Province and in the Transvaal, but none have proved of large size, the galena as a rule being found only in pockets. It is often argentiferous and associated with copper, and sometimes also with antimony.

In Cape Province lead ores are known at many places, including Banghoek, Knysna and Richmond, and in the districts of Beaufort West, Victoria West, Caledon and Swellendam.

In the Pretoria, Rustenburg and Marico districts, Transvaal, there occur deposits consisting of a number of parallel veins containing lead and copper ores. The best known of these is the mine of the Transvaal Silver and Base Metals Co., Ltd., in the Pretoria district near Argent, formerly the chief lead producer but not now in operation, in which argentiferous galena is associated with pyrite, chalcopyrite, copper carbonates and tetrahedrite in a siderite gangue. In the Edendale mine, near Hatherley, galena and zinc-blende occur in a quartz and calcite gangue.

Lead is also found at a number of other places in the Transvaal, principally in the Pretoria district.

There is always a steady domestic market for lead in various forms, which would seem to warrant greater attention being devoted to the resources of lead ore. As the dolomite is a rock that easily weathers, forming a considerable layer of soil, and as oxidised lead minerals are not very conspicuous, it is likely that a number of deposits have yet to be discovered by systematic prospecting.

The output of lead ore in the Union in 1924 was valued

at £153,288, but in 1925 this was reduced to £57,389 on account of the lessened production of the chief producer, the Transvaal Silver and Base Metals Co., Ltd.

Lime

The following varieties of limestone are known and worked in the Union: (1) Magnesian Limestone; (2) White Limestone; and (3) Desert Limestone.

The first is ordinary dolomite, which covers large areas in the Transvaal and Cape Province. It contains up to 40 per cent. of carbonate of magnesia, and is burnt in ordinary kilns to form the common blue lime used for building.

The second, which occurs largely as cave fillings in the dolomite, yields a pure white lime, used for chemical purposes, including the treatment of gold ores by the cyanide process. Small deposits of limestone free from magnesia occur in a limited area in the dolomite at Potgietersrust. A large deposit of high-grade limestone at Taungs in Bechuanaland is estimated to contain not less than 7,000,000 tons. This has been opened up, and will form a satisfactory addition to the hitherto somewhat limited resources of the Union in pure limestone.

The third limestone is found in large quantity over considerable areas. It usually contains up to 20 per cent. of silica and other impurities. It is used for cement-making near Pretoria, at Mafeking and in the Orange Free State.

Manganese

A large number of occurrences of manganese ore are known in Cape Province, Bechuanaland and in the Transvaal, but, with the exception of those in the Postmasburg district, these have hitherto proved to be of little economic importance, although capable of supplying domestic needs. The most important deposits are those of lateroidal character associated with dolomite in the Krugersdorp district. The manganese occurs as psilomelane or as pyrolusite, and the workings are a number of shallow pits in pockets of ore which are 100 yd. or so across.

Recently, attention has been directed to the important deposits of manganese ore in the Postmasburg district, which have been known since 1922, and have been lately described by A. L. Hall. They are situated about 100 miles west of Kimberley, and extend in a northerly direction from Postmasburg, having been traced for 40 miles along the Gamagara Ridge. The ore is almost entirely of psilomelane, and is in the form of a sheet up to 20 ft. thick interbedded in slates and iron-bearing conglomerates. Assays indicate a manganese content of 42 to 58 per cent.; 1·75 to 7 per cent. of silica; 3·25 to 10·9 per cent. of iron, and no phosphorus. Based on an average thickness of 4 ft., it has been estimated that 900,000 tons of ore are exposed in residual cappings, while in the case of a certain length of outcrop of the bed of average width 8 ft. and assumed to continue to a depth of only 10 ft. there are 1,800,000 tons. These figures may be considerably multiplied, for owing to minor folding there are several outliers of the ore-body. Active development is proceeding, and the immediate construction of a branch railway line from Douglas seems warranted. For further information on the Postmasburg deposits, "The Manganese Deposits near Postmasburg, West of Kimberley," by A. L. Hall (*Trans. Geol. Soc. S. Africa*, 1926, **39**, 17), should be consulted.

MICA

Muscovite mica of excellent quality is found in the Pietersburg district of the Northern Transvaal. It occurs in pegmatite veins that traverse granite and gneiss in a belt of country extending east for about 50 miles from Mica Siding on the Selati Railway. The area of the mica field is about 300 sq. miles, the principal workings being situated about the middle of the belt. The pegmatite veins are lenticular and vary in size downward from 100 ft. thick by several hundred feet long to stringers. The "books" of mica are very irregularly distributed in them and vary much in size. The record pocket, which was found in the Maury mine, was 12 ft. thick and 12 ft. long. The mica is all mined in open quarries, and from some records made on different mines the proportion of cut

saleable mica to the total amount of rock moved varied from 1 in 1,400 to 1 in 1,700 with different operating companies. The mica is carefully prepared for the market as in India, being cut into rectangles or into irregular polygons. It is of great flexibility, and possesses electrical resistance of a high order. It is mostly a pale olive-green in colour, but is occasionally almost colourless.

The remoteness of the mica field and the consequent difficulties of transport and marketing have retarded its development ; but these difficulties are being overcome. The good quality of the products marketed is being more fully recognised, as shown by the increasing exports, which include mica discs and rings. A market for a considerable amount of scrap mica on hand is being sought. There is already an export trade in this material with the United States, 500 short tons being exported in 1924. Some of it is used locally, the " splittings " being made into micanite in Johannesburg. The scrap mica exported to the United States is doubtless employed in the production of high-priced manufactured products, which are sent to various markets in many parts of the world. It would be distinctly helpful to the South African mica industry if the demand for such products in the Empire could be increased to such an extent as to make it worth while to carry on their manufacture in South Africa or some other part of the Empire. With that object in view, the officers of the Imperial Institute have recently given much attention to this problem.

Additional information on the Union's supplies of mica and corundum can be obtained from an article, " On the Mica and Corundum Resources of the Union of South Africa," by A. L. Hall (*S. African Journ. Indust.*, Dec. 1924, p. 798).

Oil Shales

Amongst the South African coals there are many seams of cannel coal, which give high percentages of oil on distillation. In addition, torbanites occur over large areas, but in limited amounts so far as is known.

Oil shales have been found over a wide area extending from Middelburg, Transvaal, to Nahainkwe in the Mata-

tiele district of East Griqualand, and also in several other parts of South Africa. The most promising occurrences are in the Ermelo and Wakkerstroom districts of the Transvaal, and the Utrecht and Impendhle districts of Natal.

The shale of the Ermelo district is rich, yielding on distillation tests 22 to 98 gal. of oil per ton, but the seams are unfortunately thin. The African Oil Corporation, which has been working on an area in the Wakkerstroom district, has proved the existence of about 7,000,000 tons of shale, which yields over a mining width of 30 ins. about 30 gal. of oil per ton. The mining conditions are good, but unfortunately the locality is 18 miles from the nearest railway and a branch line would cost £90,000 to construct. In the Impendhle district the oil shales are of lower grade than the above and their profitable exploitation is doubtful.

For further information on the Oil Shales of the Union, "Oil-yielding Rocks of the Union of South Africa," by T. G. Trevor (*S. African Journ. Indust.*, July 1923, p. 285), should be consulted.

Salt

In the Transvaal, Cape Province, and Orange Free State, are a number of salt-pans or shallow depressions, often several square miles in area, which occur in the more or less arid districts, notably in the area known as the Panne-veld, extending from Calvinia and Frazerburg in Cape Province through Griqualand West and the western part of the Orange Free State. These serve as collecting places for water and its contained salts in the rainy season, and in many cases yield suitable brines, which are converted by solar evaporation, in some cases by artificial heat, into salt, which is graded for various purposes. The industry is expanding and considerable production is possible. No natural rock-salt deposits occur in the Union as far as is known.

Soda

An important source of soda in the Union has been the Pretoria salt-pan near Hamanskraal, which has been proved to be an explosion crater, similar to those forming

the diamond pipes. The pan contains a large amount of trona, a crystallised mixture of carbonate and bicarbonate of sodium. The South African Alkali, Ltd., which works the deposit, produces about 150 tons of soda per month. The product is used largely for making arsenate of soda, solutions of which are employed for dipping cattle and for spraying fruit trees.

TALC (STEATITE)

A large quantity of talc of excellent quality occurs near Malelane in the Barberton district of the Transvaal. Talc powder for all purposes is being produced by two companies for the internal market, being used in the tanning and paint-making industries and in foundries. As the deposits are a short distance from the coast by railway, and as the material is also suitable for use in the manufacture of paper and rubber, it is not unlikely that an important export trade will be developed. An outlet is desired for the massive steatite found here in abundance.

TIN

Since 1902, South Africa has been a steady producer of tin ore, which is found over extended areas. The total production recorded to the end of 1925 has reached a value of about £5½ millions. In 1925, the tin ore produced in the Transvaal contained 1,157 tons of marketable metallic tin.

Some alluvial mining was formerly carried on in the Eastern Transvaal and also more particularly in the adjacent parts of the native province of Swaziland, where about 300 tons of tin in the form of 70 per cent. concentrates was recovered annually. These deposits are now almost all exhausted.

The Bushveld area of the Transvaal is the chief source of tin of the Union, the Red Granite and the Lower Waterberg formations being the principal tin-bearing rocks. The deposits in the Red Granite occur as pipes, as irregular bodies of altered granite, as disseminations, or in pegmatites and quartz veins. In the Lower Waterberg formation they occur as lodes along lines of fracture or

in irregular pockets. The deposits are found chiefly along the eastern and southern margins of the Bushveld. The tinfields of Potgietersrust, Nylstroom, Warmbaths and Rooiberg are on the eastern margin. There are a number of operators in the Bushveld area, most of whom are developing only. The Zaaiplaats Tin Mining Co., Ltd., is mining on the farms Zaaiplaats, Roodepoort and Groenfontein, which are situated about 23 miles west of Potgietersrust. The deposits are distributed in a well-defined zone striking N.W. and S.E. Most of the cassiterite recovered so far has been from pipes. The company is equipped with its own concentrating plant as well as a smelter. The latter commenced operations in 1917, but is now closed down as it is cheaper to export the concentrates. The Rooiberg Minerals Development Co., Ltd., which operates about 40 miles west of Warmbaths Station, mines tin ore on a number of farms, including Olivienbosch, Hartebeestfontein, Weynek, Nieuwpoort and Blaaubank. The deposits are chiefly veins in quartzites, the richest portions of which occur along bedding planes of the country rock. The company is equipped with a concentrating plant and is the largest producer. In the financial year 1923–24, 38,523 tons of ore were crushed, producing 390 tons of 66·9 per cent. concentrates. The Leeuwpoort Tin Mines Co., Ltd., also in the Rooiberg district, owns rights on the farms Leeuwpoort and Rietfontein, including alluvial ground estimated to contain 400 tons of tin. In 1925 this company milled 65,600 tons of ore containing 1·4 per cent. of tin. The tinstone occurs in veins, which are richer than those of Rooiberg, but so far only one enrichment of the country rock has been found. Some tin ore has been mined at Mutue Fides and at Stavoren, Olifants River. The ore contains scheelite, which is difficult to separate from the tinstone.

In Cape Province, tin has been found at a number of places, the chief of which is Kuils River, near Stellenbosch, where both quartz lodes in granite and alluvial deposits have been worked. Tin-mining in the Province has recently been in abeyance, but renewed attention is being given to these deposits.

Tungsten

A company was formed early in 1926 to work a deposit of wolframite ore near Pofadda in the Kenhardt district of Cape Province. The locality is about 60 miles south from Kakemas and 6 miles from the Orange River. It is estimated that, treating 2,000 short tons of ore per month, 145 tons of concentrate will be produced containing 65 per cent. of tungstic acid. It is stated that there is a clearly defined reef 4 ft. thick.

Vanadium

Vanadinite, the chlorovanadate of lead, is associated with the lead ores found in the Marico district of the Transvaal. There was some production of vanadium concentrate in 1923, when 54 tons, worth £2,716, were produced, but owing to market conditions there has been no output since that year.

The chief occurrences of vanadium ore are in the old Doornhoek lead mine and in the Kaffirs Kraal mine, both a short distance south-east of Zeerust. The former was estimated in 1920 to have 10,000 tons of ore containing 4 per cent. of vanadic oxide and the latter, in 1921, an amount of 15,000 tons, from which a 10 per cent. concentrate could be obtained containing 64 per cent. of lead.

A deposit of descloizite, a mineral containing 22 per cent. of vanadic oxide, is known near Messina, in the northern Transvaal.

Other Minerals

In the Murchison Range in the north-eastern Transvaal, to the north of Leydsdorp, is a belt of gold ores containing *antimony* from which some metal was produced during the War. *Arsenic* is found in many of the complex gold ores of the Transvaal, especially in the Barberton district, where it is being recovered at two mines, but the output is small, and does not meet the requirements of the Union for making the sodium arsenate which is used principally for sheep and cattle dipping. Deposits of *china clay* of good quality occur in the Albany division of Cape Province, not far from Grahamstown, and a pure white

kaolin is found at Nelspruit, north of Barberton. It has been reported recently that large deposits of first-grade china clay have been found near Capetown. Large deposits of *fireclay* of excellent quality and of *pottery clays* are associated with the coal measures. Firebricks and crucibles are manufactured in quantity at Boksburg, near Johannesburg and at Vereeniging. Domestic pottery is produced at Olifantsfontein, south of Pretoria. Beds of *diatomite* of fresh-water origin occur near Krugersdorp and also in the Amsterdam district of Eastern Transvaal, and in Griqualand West and Gordonia, Cape Province. So far only a limited amount has been used locally for boiler covering. *Graphite* is known in the older sedimentary rocks and in the gneissic rocks, but so far the only production has been from a small deposit in the Zoutpansberg district. *Gypsum*, which is used in the cement factories as a retarder and for making plaster of Paris, is found segregated in the more arid districts of Natal and Orange Free State. A deposit 5½ ft. thick and covering 400 acres is being worked near Fouries Rust, south-west of Boshof in the latter State. A semi-precious stone known as *South African jade*, closely resembling Chinese jadeite in appearance, but almost wholly composed of grossularite garnet, is found in the Bushveld and other places in the Transvaal. About 2,000 tons of *magnesite* is mined annually from a serpentine deposit at Kaapmuiden, but deposits are known at other localities in the Transvaal. Large quantities of aluminous *phosphates* are known to exist at Saldanha Bay on the south-west coast of Cape Province; one deposit, 4 to 15 ft. thick, has a phosphorous pentoxide content of 10 to 23 per cent. and another contains 15 to 32½ per cent. Other phosphate deposits are known in the Union. *Marble* of excellent quality and of a great variety of colour exists at Marble Hall in the North Middelburg district of the Transvaal. In Cape Province in the coastal districts of Namaqualand and Van Rhynsdorp, there are other marble deposits and a black marble occurs at Cango.

NOTES

Recent Changes in the Mining Laws of the Empire.—During the year 1925 and the first few months of 1926, there were considerable changes in the mining laws of the various parts of the Empire, while minor alterations were made in nearly every Dominion or Colony.

Africa.—It will be noted that the Uganda Mining Regulations and the Mining Mineral Oil Ordinance, 1914, are omitted from the Revised Ordinances of 1923, in consequence of the provisions of section 4 of the Revised Edition of Laws Ordinance, 1923. The reason is that fresh mining legislation, which has not yet been passed, is expected shortly.

The various East Africa colonies have been actively engaged in considering the revision of the mineral laws within the last few years. As regards Tanganyika the alterations were made before the period with which this review deals. In the case of Kenya, the mining law has been largely recast by the Mining Ordinance, 1925 (and the amending Ordinance of the same year), and by the Oil Production Regulations, 1925. The Mineral Decree of 1925 is the first Act passed in Zanzibar relating to mining.

The Model Mining Ordinance, prepared by the Imperial Mineral Resources Bureau, will, it is understood, in the near future form the basis of the new law which is being considered for Uganda.

Nyasaland has not made any changes, and the same observation applies to Northern Rhodesia; but in the case of the Dominion of Southern Rhodesia there has been passed the Mining Areas Trade Act, 1925, and the Regulation 492 of 1925 made thereunder. There is also an Act controlling the export of minerals and metals.

In Sierra Leone, the law relating to concessions is now subject to the important Concessions Ordinance, 1924, which forms Chapter 36 of the 1925 revision, and is amended by Ordinance 9 of 1925. In the Gold Coast Colony, the Gold Mining Products Protection Ordinance, 1926, amends Chapter 93. The Diamond Mining Industry Protection Ordinance, 1926, restricts dealing in diamonds. By the Non-Ferrous Metal Repeal Ordinance, 1926, the Non-Ferrous Metal Industry Ordinance is repealed. The Mining Health Areas Ordinance, 1925, passed January 1, 1926, makes elaborate provision for the health and recruitment of native labourers employed in mining. This last Ordinance is applied to Ashanti by the Ashanti Administration Sixth Further Amendment Ordinance, 1926.

Since the beginning of 1925 little change has taken place in the mining laws of Nigeria or the Cameroons.

In the Union of South Africa very important legislative changes have been made. The Diamond Control Act, 1925, considerably alters the law relating to trading in diamonds. The Mines and Works Act, 1911, is amended by No. 25 of 1926. By the Reserved Minerals Development Act, 1926, further provision is made for the prospecting and working of minerals on land alienated by the Government where the minerals are excepted from the Government grant. In the case of the Transvaal special amendments to the Precious and Base Metals Act, 1908, are effected by the Transvaal Precious and Base Metals Act, 1908, Amendment Act, 1926. A slight amendment of the Regulations made under the Precious Stones (Alluvial) Amendment Act, 1919, is effected by S. N. 1322 of 28th July, 1926, replacing G. N. 881 of May 28, 1926, and Rule 9 of the Third Schedule to the Precious and Base Metals Act, 1908, is amended by Proclamation 241 of 1925.

Apart from the Union legislation no substantial changes have occurred in the case of Natal, the only Gazette notification being G. N. 1496 of 1925, which declares carbon-dioxide gas to be a mineral.

In the case of the Cape Province, to which also the Union legislation applies, in addition to the changes noted under the Union of South Africa, certain alluvial diamond digging regulations have been approved by G. N. 1858 and G. N. 1344 of 1925. No provincial changes have been noted in the case of the Orange Free State.

In the case of the Union of South Africa there should also be noted a very important Bill to consolidate and amend the laws in force in the several provinces of the Union in relation to prospecting and mining for precious stones and to provide for matters incidental thereto. Should this Bill become law very considerable alterations in the laws relating to the prospecting and mining of precious stones throughout the Union will result. As the Bill at present stands the law relating to existing mines (subject to comparatively unimportant exceptions), remains as it is at present.

No important changes in the mining law of South-West Africa have been made apart from the substantial amendments of the Imperial Mining Ordinance of German South-West Africa effected by Proclamation No. 15 of 1925. Various proclamations (Nos. 8, 21, and 22 of 1925) create mining reserves.

America.—The changes effected in the Dominion of

Canada are not of so widespread or fundamental a character as those above-mentioned in the case of South and East Africa. Two Dominion Acts, the Yukon Quartz Mining Amendment Acts of 1925 and 1926, amend the Yukon Quartz Mining Act, 1924. As regards Dominion Regulations changes of a minor nature have been made in the case of the Alkali Mining Regulations and the Quartz Mining Regulations and a new consolidation of the Coal Mining Regulations has been issued during 1926.

In the case of British Columbia, additional regulations under the Metalliferous Mines Regulation Act are published in the *Gazette* for April 22, 1926, and later amended by the notice dated May 19, 1926. The Dominion Order-in-Council dated August 20, 1925, affects mining in the Railway Belt of British Columbia.

As regards Ontario, the Mining Act of 1925 further amends section 36*a* of the Mining Act of Ontario. Certain minor changes are made by C. 8 and C. 12 of the Statutes of 1926. The Statute Revision Amendment of 1926 involves certain repeals relating to mining, especially the repeal of the Metal Refining Bounty Act, 1914.

In the case of Nova Scotia, three Acts of 1925 affect mining, viz., C. 26 which amends the Mines Act; C. 27 which amends the Coal Mines Regulation Act; and C. 7 being an Act for the encouragement of zinc mining. As regards the rest of the Dominion, no change of importance has been noted and no change has been noted in the case of the Dominion of Newfoundland.

No substantial changes have been made in British Guiana, the changes made by the Mining (Consolidation) Ordinance, 1920, Amendment Ordinance, 1925, being very slight. Reference, however, is made to the Summary Conviction Larceny Ordinance, 1924, and to the Tax Ordinance, 1926, sections 49 and 50 of which relate to mining. The form of exploration licence issued under the Mining (Mineral Oil) Regulations, 1912, has been altered.

In the Falkland Islands the Administration of Justice Amendment Ordinance, 1925, amends the Mining Ordinance, 1918. In the case of the Caymen Islands only a minor amendment of the Oil Mines Law, 1924, is effected by the Oil Mines Law, 1924, Amendment Law, 1925.

Asia.—In the case of the Empire of India, including Burma, no important changes have been noted. A new Rule, 45*a*, relating to assignments or transfers, should, however, be mentioned. In Burma rules have been made under the Upper Burma Ruby Regulations, 1887, for the Thabeitkyin Stone Tract. Modifications of the Burma Minerals Concession Manual are to be found in List No. II.

Of these alterations, the most important is that relating to the transfer to third persons of the rights or interests of the holders of mining rights under licences or leases.

The mining law of Palestine has been entirely recast by the Mining Ordinance, 1925, and its amendment of 1925 and the Regulations thereunder and by the Mining Amendment Ordinance, 1926. It is of interest to observe that the Palestine mining law is similar in form in many of its provisions to the Model Mining Ordinance which was prepared by the Imperial Mineral Resources Bureau as an Ordinance which would best encourage mineral development in the case of Crown Colonies and the like.

In the Federated Malay States, minor alterations only are to be noted. These are to be found in Government *Gazettes* of May 14, 1926, and November 13, 1925.

In Cyprus, the mining law has been substantially altered by the passing of the Mines Regulation Amendment Law, 1925, together with the Mines Regulations, 1926, and the Mines Regulations Amendment Rules of Court, 1926.

Australia.—In the case of the Commonwealth of Australia, the Precious Metals Prospecting Act, 1926, has been passed. The Encouragement of Mining Ordinance, 1926, amends the Encouragement of Mining Ordinance, 1913. By Act No. 5 of 1926, the Petroleum Prospecting Act, 1926, petroleum prospecting and geological surveys are made the subject of substantial State assistance.

In Victoria no changes have been noted. In New South Wales, the Coal Mines Amendment Act, 1925, and the Mines Rescue Act, 1925, have been passed. Of these, the Coal Mines Regulation Act effects substantial changes.

In Queensland, the Mining Amendment Act (No. 8 of 1925) and the Coal Mining Act (No. 30 of 1925) have been passed; while in Western Australia, a Miners' Phthisis Amendment Act has become law.

No changes have been noted in South Australia or Tasmania.

In the case of New Guinea, the Mining Ordinance, 1925, amends the Mining Ordinance, 1924, which is now known as the Mining Ordinance 1922–25. The Mining Ordinance 1922–25 is further amended by the Mining Ordinance (No. 2) 1925. There is a minor amendment to the Regulations.

Statutory rules have been made in Papua under the Mining Mineral Oil and Coal Ordinance, 1923, and involve amendments of the 1924 Regulations.

New Zealand.—The Dominion of New Zealand has passed an important Coal Mines Act (No. 39 of 1925),

under which regulations have been made. Numerous amendments of the Regulations under the Mining Act of 1908 have been collected in a compilation published in 1925 by the Government Printer and entitled "Compilation of Amended Regulations under the Mining Act, 1908."

The Imperial Institute is continuing the series of publications, commenced by the late Imperial Mineral Resources Bureau, entitled "The Mining Laws of the British Empire and Foreign Countries." Until this is completed, it will not be possible to make an exhaustive survey of the laws and regulations that modify the mining laws of the Empire. It is believed, however, that the above review gives a fairly complete account of the changes that have taken place since the beginning of 1925.

The Utilisation of Slate Waste.—The Imperial Institute dealt recently with an inquiry as to the possibility of finding a market for slate waste, large quantities of which are available in North Wales. A large proportion of the slate actually quarried, in the production of roofing slate, goes to the waste dumps. According to information received at the Imperial Institute, only a comparatively small percentage of the slate quarried is marketed, the total amount of waste amounting probably to over two million tons a year. It therefore seems worth while to indicate what has been done towards the solution of this problem and point out the possible uses of this material.

The following is a typical analysis of slate: SiO_2, 53·92; TiO_2, 0·80; Al_2O_3, 24·09; Fe_2O_3, 1·87; FeO, 6·52; MnO, 0·19; CaO, 0·24; MgO, 1·80; K_2O, 3·64; Na_2O, 0·74; P_2O_5, 0·19; FeS_2, 0·13; water and loss on ignition, 5·87 per cent. Such material can be supplied in the form of a powder having the degree of fineness requisite for its use as a filler, for which it is eminently adapted.

Investigations in the United States are reported to have shown that powdered slate is equal in quality to other fillers for use in asphalt road-surface mixtures. In this connection it might usefully replace the somewhat expensive Portland cement which is used in the United Kingdom for filling the voids in certain asphalt paving mixtures. Other uses that have been suggested involve its employment as a filler for oilcloth, linoleum and rubber goods; as a base for the preparation of pigments in the manufacture of paints and distempers; and as an ingredient of soaps and cleansing agents.

Experiments recently carried out by the Building

Research Station have shown that the addition of finely ground slate waste to concrete mixtures effectively reduces their permeability to water. The possibility of manufacturing building materials from slate waste in conjunction with clay or lime has received considerable attention, and it is understood that a building material containing 85 per cent. of slate dust, and claimed to possess good strength, is now undergoing tests at Nottingham University.

It seems not unlikely that the manufacturing industries of this country could use effectively a considerable part of the slate products now going to waste. It is more particularly as an inert filler and especially as an ingredient in patent roofing material that these products merit attention. It is of interest to note that large quantities of slate waste are consumed in the United States in these ways, but mostly as granules for roofing material. The amounts of slate granules (including " flour ") sold in the United States during the years 1922–24 were as follows :

	Long tons.
1922	339,268
1923	412,732
1924	457,866

Of the total amount sold for these purposes in 1923 only 7,162 long tons consisted of " flour." Exports of slate from the United States during 1923 and 1924 included granules, the total quantity of granules so exported in 1924 amounting to 7,839 tons, the whole of this being sent to Canada. In Great Britain, however, where enormous quantities of slate waste are available, little or no use seems to have been made of the material in the manufacture of patent roofing materials and other products.

Any possible consumers of slate waste products requiring samples or further information should communicate with the Director of the Imperial Institute, South Kensington, S.W.7, who will be pleased to attend to any inquiries.

Beryl in Canada.—According to information received by the High Commissioner for Canada in London from the Mines Branch of the Dominion Department of Mines at Ottawa, Canadian occurrences of beryl, a silicate of aluminium and beryllium, have hitherto been regarded as of mineralogical rather than of commercial interest ; but a new use for the metal beryllium (glucinum), as a constituent of special lightweight alloys, has recently directed attention to the economic value of these occurrences. One of the richest deposits known in Canada is situated

in Renfrew County, Ontario, about 150 miles north-east of Toronto, near the village of Quadville. The beryl here occurs in a coarse pegmatite dike, in well-formed crystals, some of which are 2 ft. or more in length and from 3 to 6 in. in diameter. The extent of the deposit has not yet been determined, but surface conditions indicate possibilities of a large tonnage of high-grade beryl. A number of rarer minerals are associated with the beryl in this deposit.

Of various other deposits of beryl known in Canada, the most promising is situated in the Abitibi region of the western part of the Province of Quebec, 20 miles south-west of Amos on the Canadian National Railway. Beryl was discovered here some fifteen years ago when mining operations for molybdenite were being carried on. It occurs as crystals measuring up to 3 or 4 in. in diameter embedded in a mass of flaky muscovite mica containing a small amount of felspar.

The pure, deep green, transparent forms of beryl are in great demand as gemstones. Ordinary beryl is sometimes used to replace felspar in the manufacture of porcelain for use in the higher grades of spark plugs and insulators; a wider recognition of its utility for this purpose alone would probably lead to a considerable demand for the mineral. Its toughness and hardness also make it useful as an abrasive; for this purpose the electrically-fused mineral is said to have met with success. Beryllium salts are used for several purposes, the nitrate in particular being used to increase the strength of incandescent gas mantles. The difficulties involved in the commercial extraction of the metal from its ores have hitherto restricted its use, but the remarkable physical properties which render it especially useful in the manufacture of electrical and other apparatus have in the last five years been more fully recognised, and increased attention has consequently been devoted to the metallurgical problems. The more economical methods that have recently been devised for the recovery of the metal and its salts will render these available for more extensive use. This result is giving a stimulus to prospecting for beryl deposits in Canada, and may lead to important developments.

Garnet and its Uses.—The use of garnet as an abrasive has previously been briefly referred to in this BULLETIN (1924, **22**, 502). Garnet occurs at various localities in Canada, India and other parts of the Empire. Several enquiries relating to these occurrences have been received recently at the Imperial Institute, and it may therefore

prove of some interest to give a brief summary of information published recently in a bulletin (No. 256) of the United States Bureau of Mines, entitled "Garnet: its Mining, Milling and Utilisation," by W. M. Myers and C. O. Anderson.

Garnet is a common accessory mineral in a large variety of rocks, but concentrations of the mineral possessing the necessary qualifications for ornamental or industrial use are relatively few. As a gemstone, garnet has been prized since prehistoric times, and, in common with other gems, has been credited by the superstitious with the possession of certain magical and medicinal properties. Almost every one of the seven different varieties of garnet has been used for jewellery, but the fiery red pyrope is undoubtedly the most popular. It is obtained near Aussig and Teplitz in the Bohemian Mittelgebirge, which is probably the only district in the world where the collection and preparation of gem-quality garnet for market are of sufficient importance to constitute an established industry. Recently, however, a massive variety of the chromiferous garnet uvarovite has been exploited in the Western Transvaal (see p. 563), which promises to rival jade as an ornamental stone. Garnet in general does not now enjoy the popularity as a jewel which it did in former days. There was some demand at one time for garnet chips for use as watch pivots, but sapphire and ruby (especially the artificial products) are more efficient for this purpose, and garnet is now only used for the cheaper bearings. The principal use for garnet, however, is occasioned by its peculiar abrasive properties. Garnet has no true cleavage and its fracture is irregular, so that when crushed, the fragments which result are many-angled. They are roughly equidimensional, with a multitude of sharp, chisel-like cutting edges. These fragments break up in use, producing further sharp edges, and garnet seems to possess just sufficient brittleness to break up under the strain of ordinary use rather than to wear down to a smooth surface. Herein lies its peculiar advantage as an abrasive. Incidentally garnet is harder than either glass or quartz. As an abrasive, it is principally used in the form of garnet paper or cloth, but there is also a considerable quantity employed in the form of powder for grinding plate-glass. Garnet paper was first made in 1880 and began to be of commercial importance two years later. By far the greatest developments both in the mining, preparation for market, and commercial applications of garnet as an abrasive have taken place in the United States. The principal deposits are in the Adiron-

dacks in New York State; near North Creek, Warren County; near Wevertown and Johnsburg; and on Casey Mountain. In New Hampshire, abrasive garnet is quarried at Currier Hill, Merrimac County and near Danbury. In all the above, the variety of garnet is almandite, occurring principally as crystals of from ½ to 3 in. in diameter in gneiss. The garnet content of the rock seldom exceeds 12 per cent., but massive aggregates are occasionally met with. In North Carolina, rhodolite garnet is produced from garnetiferous schists on Sugar Loaf Mountain. In all cases the rock is crushed and the garnet concentrated by gravity methods by means of elaborate processes of jigs, tables, screens, etc., which differ in each individual case, and which are fully described in the publication under notice. The pure product is crushed and sized by screens into grades varying from No. 3½, which is equivalent to 20 mesh, to 7/0, which is 220 mesh. Extremely accurate sizing is demanded by the trades concerned, only 5 per cent. of the next coarser number being permissible in any grade. Garnet paper is principally employed by the wood-working industries, especially for high-class work, also by boot- and shoe-manufacturers and repairers, some metal workers, and for finishing rubber, celluloid, bakelite and other special substances. Abrasive wheels in which garnet is bonded with sodium silicate, rubber, shellac, etc., have also a limited application to some industries. Garnet does not invariably possess the qualities desirable for abrasive purposes, and the only way in which a sample can be tested for its abrasive quality is by submitting it to a manufacturer for an actual abrasive trial against a standard commercial sample.

Recent Mineral Developments in Manitoba.—The mineral output of the province of Manitoba during 1924 had a total value of $1,534,249, including: cement, $746,750 calcined gypsum, $348,212; lime, $121,518; clay products, $117,450; stone, $93,876; sand and gravel, $81,987; gold, $24,393; silver, $93; and natural gas, $60. Between the years 1917 and 1920, copper figured prominently in the output; but from 1921 to 1924 inclusive there was no output of this metal recorded, although there are copper-ore deposits of considerable magnitude in the province; the largest being that at Flin Flon Lake. Remarks on developments in connection with this deposit were made recently in this BULLETIN (1926, **24**, 115). For further details with reference to the mineral resources of the province, readers interested should refer to a useful recently-published brochure

entitled *The Mineral Resources of Manitoba*, by R. C. Wallace, which is issued and distributed by the Industrial Development Board of Manitoba, Winnipeg.

In an official statement issued still more recently, the Industrial Development Board of Manitoba reports that the mineral production of 1925 shows an encouraging increase over that of 1924, while the production of 1926 promises to exceed considerably that for 1925, even if the metalliferous deposits now being developed do not reach the producing stage by the end of the year.

The Portland cement production for 1926 is showing a striking increase in value as compared with the previous year; and it seems probable that, with the type of building now under construction in the west, this increase will be maintained.

Mining operations and development work are proceeding in the Long Lake–Bulldog Lake–Partridge Lake gold-bearing district at the headwaters of the Manigotagan River and near the Ontario boundary, at the east end of the district now generally known as the Lake Winnipeg mining district.

Active interest is being shown in the lithium mineral deposits, which have been proved to extend beyond the position where they were originally discovered (east of Pointe du Bois), to the country north of the Winnipeg River, both east and west of the Oiseau River. On Shatford Lake, west of Bernic Lake, tinstone has been found in a pegmatite, this being the first occurrence of tinstone to be noted in the province. It is suggested that the pegmatites of the Lower Bird River and Winnipeg River area are worthy of the attention of prospectors.

Investigations are proceeding to test the possibility of making more extensive use of the sands of the province, in foundry practice, brickmaking and glass manufacture. Building operations are creating a large demand for Manitoba limestone, and plant for the planing and carving of stone has been introduced to cope with this demand.

The keen interest being taken in oil development in Alberta has led to a renewal of interest in the oil possibilities of the Western Manitoba districts and drilling is proceeding at Treherne, where a supply of gas has been used for many years. Drilling has been going on for some time at Mafeking, and territory on the south flank of the Riding Mountain may also be explored.

Much of the interest now being displayed in these and other aspects of mineral development in Manitoba is connected with the proposed projection of railways northwards into the two mineral areas east of Lake Winnipeg and north of The Pas.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON MINERAL RESOURCES

The following abstracts of the more important recently published papers and reports on mineral resources relate not only to the resources of the Dominions, Colonies and India, but also to those of foreign countries. The Imperial Institute accepts no responsibility for the opinions expressed by the authors of the papers and reports referred to in these abstracts.

METALS

Aluminium and Bauxite

Nyasaland.—The Nyasaland Government Tender Board at Zomba has advertised for tenders for the whole area of Crown land on the Lichenya Plateau of Mt. Mlanje for an exclusive licence to prospect for bauxite for a period of one year, with the option then to receive a sole mineral lease for a period not exceeding 21 years, with the option of renewal, subject to a royalty of 2 per cent. on the actual sale price of the mineral sold during any year and the payment of a rent of 2s. per acre per annum.

Norway.—According to the *Metal Bulletin* (August 24, 1926, p. 10), the Aluminium Corporation, Ltd., have obtained from the Norwegian Government a water-power concession at Glomfjord for 50 years for the purpose of operating a new aluminium plant there. Production will begin on a moderate scale and expand to a maximum of 10,000 tons of raw aluminium per year, which will be approximately the production from the 38,000 kilowatts of hydro-electric energy available. The primary object of the new plant is the supplying of raw material to the Corporation's rolling mills at Dolgarrog, North Wales. The Corporation owns bauxite deposits in France.

Copper

Northern Rhodesia.—Further particulars are now available in regard to the plant for the treatment of oxidised copper ores at Bwana M'Kubwa, which commenced operations during September. The process consists, briefly, in crushing the ore to about 1 in. and drying it in modified rotary driers at a temperature of 400° to 450° C. It is then ready for a reducing action in a cylindrical furnace in an atmosphere of producer-gas. The copper minerals are thus converted to a form in

which they are soluble in an ammoniacal solution with which the ore is leached in large tanks. The copper is precipitated from the solution as a very pure oxide, which is mixed with tar and reduced to metal in a reverberatory furnace. The additional information now published in the *S. Afr. Min. and Eng. Journ.* (1926, **37**, 243–4) is concerned with the producer-gas plant and the accessory by-product recovery plant. The gas-plant necessary for the treatment of 1,000 tons of ore per day is being erected by the Power Gas Corporation, and consists of four generators for low-temperature gasification, each rated at 20 tons of Wankie coal per 24 hours. In addition there are by-product recovery and special tar de-hydration plants. Based on results obtained in England from a similar plant gasifying 60 tons of ordinary bituminous coal per day, the following yields per ton of dry coal are anticipated :

122,000 cu. ft. of gas with a calorific value of 169 B.Th.U. at 0° C. and 760 mm.
18 lb. of ammonia (NH_3) equivalent to 70 lb. $(NH_4)_2SO_4$.
17 gal. of tar (of low-temperature quality).

About 70 per cent. of the gas produced will be used in the special furnaces, while the remainder will go to the gas-engines that form part of the power plant.

Canada.—*Canadian Official Mining Notes* (issued from the High Commissioner's Office, London), reports that the Hollinger Mining Corporation is investigating copper deposits that have been discovered recently at Goshen, near Moncton in Albert County, New Brunswick. Exploration work has been in progress for some time and is being continued.

Australia.—In his presidential address to the *Chemical Society of Western Australia*, P. M. Bonnerup described recent work carried out in connection with the Nevill-Soanes process for the recovery of copper from oxidised or roasted ores. The work described was the manufacture of sponge iron (*Eng. and Min. Journ.-Press*, 1926, **121**, 889–891). Briefly, the Nevill-Soanes process consists in leaching the oxidised or roasted ore with a solution of ferrous sulphate and sodium chloride at a temperature of 70° C. Cuprous and cupric chlorides are formed, and from these the copper is precipitated in a finely divided metallic form by the action of sponge iron and recovered by flotation. Several methods of manufacture of sponge iron have been tried. The one that gives most satisfactory

results is the use of a modified down-draft gas producer. Into this, alternate layers of charcoal and iron ore (56 per cent. Fe) are charged, and the hot zone is kept at a temperature of about 900° C., at which temperature the maximum reducing effect is obtained. As the iron ore passes down the producer it is reduced to metallic iron and falls with the ash into the water seal. The product obtained is crushed to pass a 20-mesh screen and roughly concentrated on a Wilfley table, the final product containing about 58 per cent. of metallic iron, which is regarded as quite satisfactory for the purpose in view. It is inferred from the experiments that a satisfactory solution of the problem has been found, although it is likely that further improvements will be made as a result of further experience.

Gold

India.—The *Chemical Age* (1926, **15**, 229) reports the discovery near Narnaul, Patiala State, in the Punjab, of an auriferous area, 12 to 16 sq. miles in extent. Samples taken by the State Mining Engineer are reported to have assayed from 1½ to 2 oz. per ton. The ore is stated to contain 6 per cent. of copper, an amount which makes the occurrence of economic interest as a copper ore, apart from the gold.

Australia.—A description of the mines of the Wiluna Gold Corporation, Ltd., which are 120 miles east of Nannine, in Western Australia, is given in the *Mining Journal* (1926, **153**, 474). The lode system is 2 miles long and the ore reserves have been estimated at one million tons for every 100 ft. of depth, the average value being £2 per ton. The ore can be treated in a large-scale plant for £1 per ton. A 20-foot reef was disclosed by three diamond drill holes 15 years ago, at a depth of 300 to 400 ft. Further drilling has confirmed the former results, and a shaft sunk to 300 ft. depth has been the means of opening up a 42 ft. reef carrying over one-half ounce of gold per ton.

Lead and Zinc

There have been several references recently to the Harris process of lead-refining, notably at the last annual meeting of the Peñarroya Company, when it was stated that the results of working the process had been satisfactory. The method of procedure has now been described in detail in *Metall und Erz*, an abstract appearing in *Mining Journ.* (1926, **153**, 535). The crude lead is melted in a 50-ton kettle and passed in small quantities through

a fused ixture of caustic soda and salt. A regulated amount of sodium nitrate or other oxidising salt is added from time to time, the impurities being oxidised thereby in preference to the lead. The operation is carried out at a temperature of about 400° C. The impurities are easily recovered as well as the sodium salts, which can be used repeatedly in the process. If the lead has been desilverised with zinc, any small amount of zinc left in the lead is recovered in this way. Bismuth is not removed. The cost of refining depends, naturally, upon the quantity of impurities in the original lead; but a case is given where it was 5*s.* 4*d.* per ton of refined lead as compared with 9*s.* 10*d.* by another method.

Canada.—Lead and zinc in eastern Canada are discussed by F. J. Alcock of the *Geological Survey of Canada* in *Mining and Metallurgy* (1926, **7**, 51–6). High prices for these metals have led to increased search for new deposits and for information in regard to old mines that might pay to re-open. At present, the only steady producers of lead and zinc ores in eastern Canada are the Kingdon lead mine at Galetta, Ontario, and the Tetreault zinc property at Notre Dame des Anges, Quebec. The Appalachian region, including the Maritime Provinces and most of Quebec south-east of the St. Lawrence, is composed largely of Palæozoic rocks which have been much disturbed and invaded by basic and acid igneous rocks. Lead and zinc sulphides occur at many localities in this region, and two properties are attracting special attention. The Federal zinc and lead mine is in the Gaspé Peninsula near the headwaters of the Berry Mountain Brook, about 46 miles from Cascapedia. A large number of veins have been exposed in shales and limestone, containing zinc-blende, galena, pyrite, marcasite and chalcopyrite in a quartz and carbonate gangue. The Stirling zinc deposit is in the south-eastern part of Cape Breton Island, about 4 miles from the Atlantic coast and 35 miles from Sydney. The deposits are replacements, in parallel bands, of a volcanic complex, the ore minerals being zinc-blende, galena and chalcopyrite, all in a finely-divided state and intimately mixed with each other and with the gangue, which consists of unreplaced silicates of the original rock. Considerable quantities of ore have been developed at both the above mines. The neighbourhood of the granite batholith of the Gaspé Peninsula is regarded as a hopeful field for prospecting. The Grenville region extends from south-eastern Ontario through the southern Laurentian highlands of Quebec to the Adirondack

region of New York. The older rocks consist of crystalline limestone, dolomite, gneisses and schists, and are invaded by a series of igneous rocks of varied composition, ranging from granite to peridotite, known as the Buckingham Series. The region is one of considerable metamorphism, in which four deposits of zinc ore have attracted attention, viz., the Tetreault property, mentioned above; Calumet Island, Quebec; Long Lake, Ontario; and Renfrew, Ontario. All these occur, widely separated, in ancient limestones, and their similarity suggests that other such ore-bodies may be found elsewhere in this region. At various localities in eastern Ontario and in Quebec are found well-defined veins having a gangue of calcite and containing barytes and fluorspar in places. The best-known example of this class of deposit is the Kingdon lead mine. Others of the same type are the Frontenac lead property, near Perth Road, Ontario; the Hollandia lead mine, near Bannockburn in Hastings County, Ontario, in which neighbourhood there are a number of galena-calcite veins; and numerous others throughout eastern Ontario. In northern Ontario and Quebec, several properties are attracting attention as possible producers of lead and zinc. Notable amongst them is the Amulet and other properties in the Rouyn district, Quebec. The east side of Lake Timiskaming, and the neighbourhoods of Sudbury, Lake Geneva and Sault Ste. Marie are also mentioned as localities where development of lead and zinc deposits has been carried out recently.

In *Canadian Official Mining News Letter* No. 88, issued by the High Commissioner for Canada, W. E. Cockfield describes recent developments in the Mayo district, Yukon. Production from the established properties continued steadily throughout 1925, and several others were brought to the point of production. The Treadwell Yukon Co., Ltd., commenced running the first concentration mill in the district, and shipped 1,135 tons of concentrates, containing 52 per cent. of lead and 584 oz. of silver per ton, up to the end of August 1925. This Company has found the vein which has been faulted on the lowest level, and has consequently increased its reserves materially. Several promising ore-bodies have been found on Galena Hill, immediately to the west of Keno Hill, and 375 tons of high-grade ore have been shipped from the Arctic and Mastiff Claims. In the more recently discovered Beaver River Area, about 45 miles north of Keno Hill, some prospecting was done in the summer of 1925. On account of lack of transport facilities, it is believed that large ore reserves will have to be shown before the expense of provid-

ing facilities can be justified. The ores of this area contain much less silver than those of the Keno Hill area, but active prospecting is in progress.

Australia.—*Western Australia.*—The developments at Braeside were briefly referred to in a recent issue of this BULLETIN, (1926, **24**, 117). A more detailed account has now been given by C. M. Harris in *Chem. Eng. Min. Rev.* (1926, **18**, 355–8) as a result of a recent visit of inspection to the field. Occurrences of lead ore have been found over an area of about 40 by 4 miles. This area lies about 250 miles east of Port Headland, and extends south from the Barramine estate, east of and parallel to the Oakover River. The most important work has been done on the Ragged Hill lease, near the south end of the field, where a shaft has reached a depth of 88 ft. and is being continued to water-level, which is expected to be at about 130 ft. At the surface there were about 5 ft. of solid galena and about 1 ft. of galena and quartz on each wall. At a depth of 10 ft. lead carbonate appeared, and at 60 ft. the lead content decreased to about 40 per cent. Patches of galena then re-appeared and mixed ore continued to the bottom of the shaft. The outcrop of this lode has been traced for 1,800 ft., and a continuous length of about 250 ft. has a possible average of 25 per cent. lead over a width of from 2 to 3 ft. A number of other shafts have been commenced on the field, but were abandoned at shallow depth on reaching the oxidised zone. The country is very rugged and broken up, the drainage cutting across the general line of strike. The rocks are a complex series of pre-Cambrian age, with later intrusions of dolerite. It is 100 miles from the field to the Marble Bar railway, and under present conditions the cost of landing concentrates at Fremantle is £11 per ton for freight alone. Unless developments prove the ore-bodies to be of sufficient importance to warrant the cost of extending the railway, the field generally is unlikely to be payable.

Mexico.—The production of zinc ores in Mexico has been increasing constantly in recent years. In 1921, the zinc content of ore produced was 1,256 metric tons, and for eleven months of 1925 it was 31,954 metric tons. It is, therefore, timely that A. J. Garcia should deal in detail with the zinc industry in Mexico in the current number of the *Boletin Minero* (1926, **21**, April, 125–191). The principal State producing zinc ores in 1924 was Chihuahua, the zinc content of ore produced being 16,657 metric tons out of a total for the whole country of 24,473 metric

tons. In the same year, Coahuila produced 4,369 metric tons; while Nuevo Leon, Zacatecas, San Luis Potosi and Jalisco produced smaller quantities. Deposits of zinc ores are known also in many other States. An English company is the only producer in Chihuahua, and an American company is the principal producer in Coahuila. The chief deposits and treatment plants in all States are described, and a list is given of all properties held for lead or zinc. Conditions under which mining property is held or obtained form the subject of a separate chapter, while other information is given under railway rates, customs, tariffs, statistics and general trade in zinc. Most of the ore raised is concentrated and exported to Europe, taking the place of Australian concentrates that are no longer available for continental smelters. There are a number of concentrating plants supplied with ore from small purducers. A zinc distillation plant with a capacity of 3,000 tons of ore per month has been erected near Saltillo in Coahuila, but does not appear to have been successful hitherto. Another distillation plant, with a capacity of 16 tons of zinc per day, has commenced production at Nueva Rosita, 12 miles west of Sabinas in Coahuila.

Tin

South-West Africa.—The rise in the price of tin has stimulated prospecting and production of cassiterite in Damaraland, where both lode and alluvial deposits extend on each side of the narrow-gauge railway for 100 miles north-west from Karibib. Between 20 and 30 tons is being won monthly by hand crushing and winnowing of outcrops according to the *S. Afr. Min. and Eng. Journ.* (1926, **37**, 206). The recovery is poor, but a clean concentrate is obtained and good profits are made. The mining laws favour the prospector. Excepting two concessions, the whole country is open to pegging, the landowner having no mining rights, but receiving a quarter of the royalty, the latter amounting to 2 per cent. The licence for a claim (1,200 × 600 metres) is 5*s*. per month.

Australia.—The present price of tin is stimulating work on the north-eastern coast of Tasmania, where several old fields are being revived and new finds made. A tin and wolfram mine at Storey's Creek, about 15 miles east of Avoca, has been favourably reported on by A. McIntosh Reid. Two lodes are being worked, each being about 600 ft. long and 3½ ft. wide. One contains about 2 per cent. of tungstic oxide and 1 per cent. of tin, while

the other contains about 2 per cent. of tin and 1 per cent. of tungstic oxide. Other finds are reported 2½ miles from Storey's Creek; between the Gordon and Contact mines, 2½ miles from Branxholm; at the Paris mine; and near the Arba mine. Tin oxide is being won from shallow alluvial deposits at Ruby Flat (*Argus*, 1926, April 30, and *Chem. Eng. Min. Rev.*, 1926, **18**, 318).

NON-METALS

Bentonite

United States.—" Mining Bentonite in California " is the title of an article by J. Melhase in *Eng. Min. Journ.-Press* (1926, **121**, 837). The local industry arose in response to the demand for cheap and efficient substitutes for imported fuller's earth, which is consumed in large quantities by the oil refineries. The principal deposits are those in Southern California near Otay in San Diego County, and along the Amargosa River in Inyo County, extending over the border into Nevada. Other deposits occur at Fish Springs, Imperial County; Coalinga, Fresno County; and Daggett, San Bernardino County.

The Otay bentonite, known as " otaylite," occurs near the middle of a series of shallow-water marine deposits of Upper Miocene and Lower Pliocene age. There are several thin strata of bentonite of different colours making up a thickness of 4 to 6 ft. along the western outcrop, but thinning out eastwards. The deposits cover several thousand acres at a depth of about 100 ft. The Daggett deposits are small, but interesting because they are enclosed as pockets of 10 to 200 tons in rhyolite of Tertiary age, from which they appear to have been derived by alteration *in situ*. The Amargosa River deposits are the most extensive, and at one time probably extended across the whole of the Amargosa Basin. They are worked near Ash Meadows, near Shoshone and near Stump Springs. A variety containing an admixture of gravel is found in a canyon 4 miles S.E. of Tecopa. While the latter is of Tertiary age, the others are the result of the alteration of a bed of volcanic ash intercalated with a series of brackish water sediments of Recent age. The bentonite beds are from 1 to 10 ft. thick and the substance is known locally as " amargosite." Except at Ash Meadows, the beds are worked by stripping the overburden. When freshly mined, bentonite is damp and sticky; it is therefore spread in the sun to dry, being periodically stirred by horse-drawn harrows or by hand shovels. At the end of

a week the material has been reduced to small lumps and the moisture content has dropped from 30 per cent. to 7 per cent. The product is then bagged and sent to refineries. In preparing bentonite for refining heavy lubricating oils, kerosene and lighter fractions, the material is first dried at 230° F. It is then ground to an impalpable powder and after being treated for several hours with about 45 per cent. of its weight of 96 per cent. sulphuric acid, it is drained and thoroughly washed with water. The efficiency of acid-treated bentonite in decolorising oils is stated to be much greater than that of fuller's earth. About 1 lb. of prepared bentonite is used per barrel of light fractions, and up to 100 lb. per barrel of dark, heavy, lubricating oils. It may be used several times over for light oils, but with heavy oils it is necessary to wash the clay after each application. Bentonite loses efficiency after each application and can only be used economically three times. The consumption has reached nearly 2,000 tons per month, nearly all of which is taken by oil-refineries near Los Angeles and around San Francisco Bay.

Cement

United Kingdom.—In *Min. Journ.* (1926, **153**, May 22, 412) there appeared an abstract of a paper presented to the Master Builders' Association by H. Keeble on "Quick-hardening Cements and their Application." The difference between quick-setting and quick-hardening is pointed out. A cement which loses its plasticity (i.e. sets) in 3 or 4 minutes may well be weaker at the end of 24 hours than an ordinary slow-setting Portland cement, quick-setting being really detrimental to ultimate strength.

Modern rapid-hardening Portland cements, of which "ferrocrete" is a well-known example, are merely ordinary Portland cements in the manufacture of which special care has been exercised in compounding of ingredients and control of burning temperature, followed by extremely fine grinding of the product. Such material is somewhat more expensive than ordinary cement in first cost, but, in view of its more rapid maturing, and greater ultimate strength, economies can be effected by its use, both in time and quantity of cement employed, which more than repay the additional outlay. It is stated that a mixture consisting of 6 parts coarse aggregate, 3 parts sand and 1 part rapid-hardening Portland cement, will have the same strength in 28 days as a 4 : 2 : 1 mixture in which ordinary Portland cement is employed. Therefore, where density is not of primary importance, it is actually cheaper

to use the more expensive cement. Where rapid hardening is required, the mixture must, of course, be in the same ratio as if ordinary cement were used. The author believes that in a few years, rapid-hardening cements will become standard.

The new alumina cements are rapid-hardening, but they are not Portland cements. They harden even more rapidly, and their initial cost is much greater. It is stated that in practice alumina cement attains in one day a strength equivalent to that of quick-hardening Portland cement in 4 days and ordinary Portland cement in 28 days. It is argued that full advantage of this very rapid hardening cannot be made use of in practice because, in any kind of reinforced concrete work, density is an important consideration if the reinforcing material is to be prevented from rusting, and for this purpose a mixture in the ratio of 4 : 2 : 1 is the minimum necessary. Therefore, apart from the increased ultimate strength, which cannot be utilised, there would be no advantage in using this much higher-priced article. The author contends that while alumina cement withstands the effects of sea-water, a properly-graded and properly-laid Portland cement also possesses this property. The use of alumina cement is definitely advantageous where it is important for the work to be ready to bear strains within 48 hours of being laid. An interesting feature in the setting of alumina cement is that the set takes place from the centre outwards and heat is generated, so that the surface of the work must be kept wet, or it is likely to powder. This heat generation enables alumina cement to be laid in frosty weather. It is stated that, if alumina cement is mixed with Portland cement, a quick-setting product results, so that care must be exercised in changing over from the use of one to the other to see that all tools, mixers, etc., have been well cleaned.

Australia.—About the middle of 1925 it was reported (*Ind. Aust. Min. Stand.*, 1925, **74**, Aug. 6, 165) that a new cement works at Railton, Tasmania, had commenced experimental production. These works have now started productive operations on a commercial scale, which are expected to be continuous (*ibid.*, 1926, **75**, April 1, 387). It was originally intended to erect the works at Berriedale, where suitable raw material is available, but the present site at Railton was chosen with a view to the utilisation of the local deposits of oil-shale as a fuel for cement-burning. It has, however, been found inadvisable to depart from the orthodox method of burning by means

of pulverised coal, and the oil-shale will be worked independently. It will be necessary to employ coal only for the actual burning in the kilns, all other power being supplied by the State Hydro-Electric Department at a very cheap rate. The situation of the works permits of easy distribution to all mainland ports. Cement produced at Railton is to be used in the construction of the Sydney Harbour bridge.

The importance which the cement industry is assuming in Australia is illustrated by figures quoted by *Ind. Austr. Min. Stand.*, 1926, **75**, May 20, 576. The annual capacities of plants erected and under construction in November, 1925, were as follows:

State.	Erected. *Tons per annum.*	Under construction. *Tons per annum.*
New South Wales	435,000	135,000
Victoria	182,500	—
Queensland	60,000	—
South Australia	82,000	—
Western Australia	36,000	—
Tasmania	35,000	25,000
Total	830,500	160,000

The total sales of cement in Australia, for the year ending November 30, 1925, are given as 555,240 tons, of which only 20,045 tons were imported.

Germany.—The process employed at the Leverkusen works of the I. G. Farbenindustrie A.-G., for making Portland cement from gypsum is described under "Gypsum and Anhydrite," on p. 586.

Coal

Australia.—Details of a process invented by A. G. Black, of Melbourne, for the carbonisation of the brown coal of Altona, Victoria, are given in the *Iron and Coal Trades Review* (1926, **112**, 973). One ton of coal yields on distillation a crude oil and other by-products, and one-half ton of "charcoke" residue, which is briquetted. An analysis by the Government analyst of the coke gave: water, 3·03; volatile matter, 15·96; fixed carbon, 77·88, and ash, 3·13 per cent. The calorific value was 13,520 B.Th.U. A plant is to be built at Altona.

A company, the Seymour Coal Mines, Ltd., has been formed to exploit the deposits of coal, estimated to contain 30 million tons, at Seymour, on the east coast of Tasmania, between Hobart and Launceston. According to the *Industrial Australian and Mining Standard* (May 13,

1926, p. 558) various analyses of the coal show its calorific value to be between 12,930 and 13,163 B.Th.U. The main workings will be ½ mile only from the loading pier in the harbour. The utilisation of this coal will render Tasmania less dependent upon coal from New South Wales, the supply of which is occasionally curtailed through industrial troubles; moreover, freight charges will be less.

New Zealand.—The *Chem. Eng. and Min. Rev.* (May 5, 1926, p. 315) describes the installation of the Stockton Coal Company at Westport for transporting coal in a flume from their Fly Creek section to the shipping bins at Westport, a distance of 5¾ miles. During a trial run, 65 tons of coal were conveyed the whole distance in 36 minutes without appreciable damage. It was estimated that the carrying capacity of the flume is 150 to 180 tons per hour, and that there will be a considerable saving in transport charges over an electric haulage system.

Diamonds

Tanganyika.—According to the *Financial Times*, July 9, 1926, P. Wagner has contributed a paper to the South African Association for the Advancement of Science, in which he states that he has examined specimens of the parent rock in which the Tanganyika diamonds are found, and has reached the conclusion that it consists of basaltic kimberlite, probably constituting a true pipe. This is the most northerly occurrence of kimberlite yet recorded in Africa.

Fluorspar

Queensland.—Two fluorspar occurrences in the Mungana district are reported on by C. C. Morton, Government Geologist, in *Queensland Govt. Min. Journ.* (1926, **27**, 202). One is on Muldiva Creek, about 6 miles south-west of Mungana, where two fissure-lodes in granite have been worked and two others are known. About 500 tons of fluorspar, containing 90 to 95 per cent. CaF_2, have been shipped to Chillagoe smelters. The other occurrence is about 3 miles farther to the south-west. The vein is clearly defined for a distance of 20 chains. It is in micaceous schist at one end, where it is very siliceous, but the best outcrops of fluorspar occur in granite, and are found at intervals over a distance of 10 chains. The width occupied by fluorspar varies from 6 in. to 5½ ft. A large tonnage of the mineral could be quickly and cheaply extracted from this deposit under favourable economic

conditions. At present, cartage to Mungana costs £1 per ton, while rail freight to Chillagoe is 16*s*. 3*d*. per ton.

Gypsum and Anhydrite

The *Chem. Trade Journ.* (1926, **79**, July 2, p. 3) contains an article on the manufacture of ammonium sulphate and sulphuric acid from gypsum. The former process, which was designed to meet the needs of the synthetic ammonia industry, is now employed not only at the Oppau and Merseburg works of the I.G. Farbenindustrie A.-G. in Germany, but also at the Billingham works of Synthetic Ammonia and Nitrates Ltd. in England. The ammonia produced from atmospheric nitrogen is first converted into ammonium carbonate, which is then caused to react with finely-divided gypsum or anhydrite so that ammonium sulphate and carbonate of lime result. The whole of the ammonia is not converted into sulphate, but the by-product carbonate of lime contains some ammonia and has therefore an enhanced agricultural value.

The development of the process for making sulphuric acid from gypsum and anhydrite has been entirely in the hands of the Bayer Company (now incorporated in the I.G.), but details of their methods had not been made public until an account of the whole process was given by W. J. Müller at a meeting of the Verein deutscher Chemiker last October. This was recently published in *Zeit. angew Chem.* (1926, **39**, Feb., 169). Intensive investigations were commenced in 1915 with a twofold object, (*a*) to drive off the whole of the sulphur from the gypsum in the form of oxides of sulphur, and (*b*) to ensure that the lime residue should be in a form in which it could be readily marketed. As regards (*a*), it was known that calcium sulphate dissociates at a lower temperature in the presence of carbon than by itself, and also that in order to drive off all the sulphur dioxide, the sulphate has to be mixed with substances containing silica or alumina. Laboratory experiments led to the conclusion that, if a mixture of gypsum and coal with aluminous and siliceous substances could be devised such that the residue after roasting had the composition of the mixture normally employed for the production of Portland cement, both of the above objects would have been achieved. After surmounting great difficulties, both at the laboratory stage and later on a commercial scale, the process was proved to be practicable, and even became more successful commercially than had been anticipated. It was estimated that by February, 1926, the works at Leverkusen would be turning out

2,300 tons of sulphur trioxide and 3,000 tons of cement clinker per month. This plant is being greatly extended and the process is being adopted at other works of the German combine. Briefly, the method employed is that covered by D. R. Patent No. 388,849. The process is exactly analogous to that employed for the production of Portland cement from limestone, except that sulphur dioxide gas is evolved, from which sulphuric acid is manufactured, instead of carbon dioxide gas, which is a waste product. A finely-ground mixture of gypsum, anhydrite, or precipitated calcium sulphate, coke and clay-slate is fed into rotary kilns fired with pulverised coal (waste brown-coal dust suffices) and sintered. Three essential conditions must be satisfied: (1) the mixture must be introduced into the furnace dry, (2) a weakly oxidising atmosphere must be maintained in the furnace, and (3) the theoretical amount of carbon in the mixture must be considerably reduced in order to prevent the formation of calcium sulphide; half the theoretical amount being used in practice. The kilns are 50 metres long and 2½ metres in diameter, and are each capable of handling 100 tons of mixture per day. The gases evolved contain 6 to 7 per cent. of sulphur dioxide, which, after purification, is converted into sulphuric acid either by the contact or the chamber process. The cement clinker residue from the kiln is ground with blast-furnace slag and sold as blast-furnace cement. This is of good quality. It is stated that 136 tons of anhydrite will produce 84 tons of clinker and 98 tons of sulphuric acid (strength not stated), and the cost of producing the cement is alleged to be no greater by this method than by the usual process of manufacture from limestone.

Petroleum and Allied Products

Canada.—The Minister of Public Works and Mines in Nova Scotia has confirmed the announcement that an exclusive oil exploration licence has been granted over 5 million acres in Nova Scotia to the New York firm of H. L. Doherty & Company. The same firm had previously secured similar rights for Prince Edward Island, where a test bore has reached a depth of 1,400 ft. The Company has also contracted for exploration rights over Pictou Island, where it is stated that a well-defined anticline follows the whole length of the island. Another American company is boring for oil in Inverness County, Nova Scotia, under exclusive rights of exploration (*Canad. Min. Journ.*, 1926, **47**, 694).

Australia.—The search for oil in Australia formed the subject of an interesting paper by Arthur Wade before the *Institution of Petroleum Technologists* recently (*Journ. Inst. Petr. Techn.*, 1926, **12**, No. 55, 145–172). After giving an account of the attempts that have been made to find oil in Australia and New Guinea, the author reviews his own work as adviser to the Commonwealth Government from 1913 onwards. The shale-oil industry was at one time successful in New South Wales, but competition from imported oil, and internal troubles in the industry itself, caused it to languish. It is hoped, however, that a new lease of life will be given to it by means of renewed interest and new methods, in which case the demand for an internal supply of oil will be largely met. Much of the early drilling for oil was badly directed owing to misapprehension of the nature and origin of the bitumen found along the coasts and of the coorongite found inland. Present activities are being much more scientifically and expertly directed. The Tertiary formations that have been studied do not appear to be very promising, and Wade thinks that the older formations offer the best prospects for finding oil in commercial quantities. In two cases he found evidence of denuded oilfields of which only the last traces are left. On the whole, despite disappointments up to the present, there are still hopes of oil deposits being discovered. Much detailed work is required before a continent as large as Australia can be condemned. A great part of Australia has not yet been geologically examined or mapped, while other large areas have only been covered by rapid reconnaissance surveys. It is estimated that not more than 1 per cent. of the continent has been mapped in such detail as our British maps show. It is therefore possible that there may be areas of equal or greater interest than those dealt with.

The Joint Committee of Public Accounts of the Commonwealth Parliament have now issued two parts of their report upon *The Expenditure on Oil Exploration, Development, Refining, etc., in the Commonwealth and Papua* (Melbourne, Government Printer: Part I, No. 34—F. 17820, 1925; Part II, No. 11—F. 2351, 1926). Recognising the importance of adequate and regular supplies of oil being available within Australia, if possible, for industrial and defence purposes, the Committee not only investigated Commonwealth expenditure, but also inquired into the steps being taken to render Australia less dependent on outside sources for motor spirit, fuel and lubricating oils, and similar commodities.

Part I comprises an introduction, an account of the

Committee's proceedings and the result of their inquiries into oil exploration in Papua and in Australia. The conclusions reached are (1) that further detailed geological mapping in the Roma district of Queensland and the Kimberley district of Western Australia should be undertaken, and trial borings conducted where favourable structures are found; (2) that certain areas in New South Wales offer prospects of supplies of natural gas; (3) that it is better to assist systematic investigations than to offer rewards for success in finding oil; (4) that the prospects of oil being discovered in Papua are hopeful and (5) that in the event of oil not being found in commercial quantities under the present agreement with the Anglo-Persian Oil Company, the work should be continued.

As a result of representations made by the Committee at an early stage of its inquiry the Commonwealth Government convened a conference of geologists and others qualified to discuss the subject of the creation of a Federal Geological Survey. The conference passed a number of important resolutions, including a recommendation to establish such a Survey, and the Committee point out that the annual cost of the organisation proposed would be about £43,000. They state that they had not in mind the creation at the outset of such an elaborate organisation; also that they are of the opinion that an efficient Federal Geological Survey can be created for a considerably smaller annual amount and can achieve the desired objects. A minority of the Committee consider that the recommendations of the conference of geologists should be adopted and put into operation.

Part II deals with shale-oil, power alcohol, liquid fuels, etc. In regard to shale-oil the Committee recognised the limitations of this industry as a commercial proposition and approached the question from the aspect of national defence, for which purpose they had no doubt of its importance. They found that the Australian shale deposits on a conservative estimate would only yield supplies for about 25 years at the present rate of consumption of oil, and concluded, therefore, that the deposits should be regarded as a national asset and conserved as an insurance against a time when Australia's supplies from overseas might be threatened. They recommended unanimously that steps should be taken to have the oil-shale deposits of Australia vested in the Commonwealth, and that experimental research work should be continued to the point of production, so that the works could be placed on a nucleus basis in conformity with the policy already controlling the munitions factories. Although the manu-

facture of power alcohol and other liquid fuels from vegetable crops, coal and other sources would supply the lighter oils required, it would remain for the shale-oil to provide the equally essential heavier classes of oil.

Phosphates

Irish Free State.—According to *The Fertiliser, Feeding Stuffs and Farm Supplies Journ.* (1926, June 16, p. 441), samples of phosphate rock taken from a deposit between Kilfenora and Ballyvaughan in County Clare were exhibited by the Irish Department of Agriculture at the Dublin Spring Show. Inquiries at the Department of Agriculture elicited the information that that Department is carrying out manuring trials with this material on grass-land and turnips during the present season. The material employed for these experiments contained 46 per cent. tri-calcium phosphate. The thickness and extent of the deposits are not stated.

Canada.—Prospecting by parties sent out by the Consolidated Mining and Smelting Co. of Canada, has resulted in the discovery of phosphate beds over a large area in the East Kootenay district, British Columbia. Claims have been applied for to the west of the Elk River near Fernie, and also 6 miles north of the confluence of the Fording and Elk rivers (*Eng. Min. Journ.-Press,* 1926, **121**, 738). Commenting on the discovery, the *Amer. Fert.* (1926, **64**, June 12, 28) points out that Canada, at the present time, imports large quantities of phosphates from the United States, while sulphuric acid is a waste product at the Consolidated Smelter at Trail, B.C. An economic outlet for this acid in the manufacture of superphosphate from local raw material would not only prove a great saving to the company, but would also lay the foundation of a new industry.

Salt

India.—The Maurypur salt works are about 8 miles west of Karachi on the seaward edge of the Moach plain. They cover about 180 acres, lying between the high-water mark of the normal spring tides and the still higher tides of June and December. The method of salt recovery, which is somewhat different from the ordinary practice, is described by J. A. Dunn (*Rec. Geol. Surv. India,* 1925, **56**, Pt. 4, 384–6). The works are protected from inundation by an earthwork completely surrounding them. A trench is dug all round inside this embankment and

another trench, 4 ft. deep by 7 ft. wide, is dug on the outside on the seaward side of the embankment. The outer trench fills with sea water each fortnight at spring tides, and by communicating sluices fills the main inner trench as well as subsidiary trenches which subdivide the area of the works. The total length of inner trenches is about 5,800 yds. The works are let to the salt workers in plots, each consisting of 20 salt pans 29 ft. square. Brine is raised from wells varying in depth from 1½ ft. to 17 ft. according to their distance from a trench, and is evaporated in the pans in the usual way. The trenches act as a supply reservoir, increasing the flow of brine in the wells, and also as condensers. The concentration of the water in the trenches is from 8° to 13·5° Baumé as compared with 3° for the sea water on the shore. These works produce from 11,000 to 16,000 tons of salt per annum, and it is proposed to increase this to 200,000 tons by developing a further 1,600 acres. In discussing this project, Dunn calls attention to the pernicious system at present in use whereby all mother liquors remain in the area of manufacture.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, June–August, 1926.

The publications issued by the Governments of the Crown Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, *Millbank, Westminster, S.W.*1. *Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

General

The Geology of the Carlisle, Longtown and Silloth District. By E. E. L. Dixon and others. Mem. Geol. Surv. England and Wales. Explanation of Sheets 11, 16 and 17. Pp. 113 + xiii, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 2*s.* 6*d.* net.

Government of the Gold Coast Report on the Geological Survey for the Period April, 1924–March, 1925. Pp. 30, 13 × 8½. (Accra: Government Printer.)

Geology and Mineral Resources of Nyasaland. By F. Dixey. *Mining Mag.* (1926, **34**, 201–212).

Report of the Director, Geological Survey of Southern Rhodesia, for the year 1925. Pp. 5, 13 × 8. (Salisbury, Rhodesia: Government Printer, 1926.)

Geology and Mineral Resources of British Somaliland. By R. A. Farquharson. *Mining Mag.* (1926, **34**, 265–276, 329–340.)

Geology and Economic Minerals of Canada. Economic Geology Series No. 1. By G. A. Young. Geological Survey, Canada. With Annotated List of Economic Mineral Deposits in Canada, to accompany mineral map of the Dominion of Canada, 1924. Pp. 187 + 57, 9¼ × 6¼. (Ottawa: King's Printer, 1926.)

Investigations of Mineral Resources and the Mining Industry, 1924. No. 642, Mines Branch, Canada. Pp. 118, 9½ × 6½. (Ottawa: King's Printer, 1926.)

Investigations in Ore Dressing and Metallurgy, 1924. No. 643, Mines Branch, Canada. Pp. 115, 9½ × 6½. (Ottawa: King's Printer, 1926.)

Synopses giving Data on Minerals and Industrial Raw Materials along the Lines of the Canadian Pacific Railway, 11 × 8½. (Montreal: Development Branch, Dept. Colonisation and Development, Canadian Pacific Railway, 1926.)

The Mineral Resources of Manitoba. By R. C. Wallace. Pp. 48, 9 × 6. (Winnipeg: Industrial Board of Manitoba, 1925.)

Geology and Mineral Deposits of Oiseau River Map-Area, Manitoba. By J. F. Wright. Summary Rept., 1924, Part B, Geological Survey, Canada. Pp. 51–104, 9½ × 6½. (Ottawa, King's Printer, 1926.)

Wapawekka and Deschambault Lakes Area, Saskatchewan. By J. S. De Lury. Summary Rept., 1924, Part B, Geol. Survey, Canada. Pp. 23–50, 9½ × 6½. (Ottawa, King's Printer, 1926.)

Report on the Administration of Burma for the year 1924–25. Pp. 97, 9½ × 6, with Map. (Rangoon: Superintendent Govt. Printing and Stationery, Burma, 1926.) Price 4*s*. 6*d*.

Report on the Administration of the Mines Department and on the Mining Industries, Federated Malay States, for the year 1925. Pp. 19, 5 charts, 13 × 8. (Kuala Lumpur: Federated Malay States Government Press, 1926.)

Federated Malay States. Geologist's Annual Report for the year 1925. 11 pp. with appendices, 13 × 8. (Supplement to the F.M.S. Government Gazette, April 30, 1926.)

A List of Minerals found in British Malaya, together with a Description of their Properties, Occurrences and Uses. By E. S. Willbourn. Reprint from Journ., Vol. 3, Part 3, December, 1925. Malayan Branch Royal Asiatic Society. Pp. 57–100, 9½ × 6.

A Contribution to the Mineralogy of New South Wales. By G. Smith. Mineral Resources No. 34, Geol. Survey N.S.W. Pp. 145, map and plates, 9½ × 6. (Sydney: Government Printer, 1926.) Price 3*s*. 3*d*.

The Mineral Deposits of New Zealand. Pp. 23, 8½ × 5½. (Wellington: Government Printer, 1925.)

The Geology of the Whangarei—Bay of Islands Subdivision, Kaipara Division. By H. T. Ferrar and others. Bull. 27, Geol. Survey Branch, New Zealand. Pp. 134, 11 × 8½. Maps in cover. (Wellington: Government Printer, 1925.)

Übersicht über die nutzbaren Bodenschätze Spaniens. By F. Schumacher and others. Supplementary Publn. No. 1, Internat. Bergwirts. Pp. 109, 9 × 6. (Leipzig: C. L. Hirschfeld, 1926.)

Mineral Industry of Alaska in 1924 and Administrative Report. By P. S. Smith. Bull. 783–A, U.S. Geol. Survey. Pp. 39 + vii, 9 × 6. (Washington: Government Printing Office, 1926.)

Mining in Colorado. A History of Discovery, Development and Production. By C. W. Henderson. Prof. Paper 138, U.S. Geol. Survey. Pp. 263, 11½ × 9. (Washington: Government Printing Office, 1926.)

Turkey: a Commercial and Industrial Handbook. By G. B. Ravndal. Trade Promotion Series No. 28, U.S. Dept. Commerce. Pp. 232, 9 × 6. (Washington: Government Printing Office, 1926.) Price 75 cents.

Geologie und Mineralvorkommen von Persien. By R. Range *Zeits. f. prakt. Geologie* (1926, **34**, 49–53).

Die Bodenschätze Turkestans. By Muschketow. *Internat. Bergwirts.* (1925–26, **1**, 188–190).

The Minerals of Insulinde. *Netherlands Indies Rev.* (1926, **7**, 7–9).

The International Control of Minerals. Pp. 171, 9 × 6. (Published jointly by the Amer. Inst. Min. Met. Eng. and the Min. and Met. Soc. of America, New York, 1925.)

Electrical Precipitation in the Chemical Industry. By H. W. C. Henderson. *Industrial Chemist* (1926, **2**, 161–165).

Some Aspects of the Application of Electricity to Mining. By J. A. B. Horsley. *Trans. Inst. Min. Eng.* (1926, **71**, 268–299 with discussion).

Sodium Cyanide in Flotation. By W. E. Simpson. *Mining Mag.* (1926, **35**, 9–14).

Magmas and Igneous Ore Deposits. By J. H. L. Vogt. *Econ. Geol.* (1926, **21**, 207–233, 309–332).

METALS

Alloys

Some Sand-cast Alloys of Aluminium containing Cobalt. By S. Daniels. *Ind. Eng. Chem.* (1926, **18**, 686–691).

Recherches sur le Traitement thermique des Alliages Aluminium-Cuivre. By L. Guillet and J. Galibourg. *Rev. de Mét.* (1926, **23**, 179–190).

Aluminium and Bauxite

Bauxite on the Gold Coast. By L. T. Emory. *Eng. Min. Journ.-Press* (1926, **121**, 443–446).

Cobalt

A Gold-Cobaltite-Lodestone Deposit, British Columbia, with Notes on the Occurrence of Cobaltite. By W. L. Uglow and F. F. Osborne. *Econ. Geol.* (1926, **21**, 285–293).

Copper

The Britannia Mines, British Columbia. By S. J. Schofield. *Econ. Geol.* (1926, **21**, 271–284).

La Nueva Minería del Cobre en Chile. *Bol. Minero de la Soc. Nac. de Minería de Santiago.* Abstr. *Revista Minera* (1926, **77**, 213–215).

Features of the Magma Copper Smelter. By L. S. Austin. *Eng. Min. Journ.-Press* (1926, **121**, 643–644).

Underground Leaching at Cananea. By C. C. Greenwood. *Eng. Min. Journ.-Press* (1926, **121**, 518–521).

Differential Flotation of Copper at Cananea. By A. T. Tye. *Eng. Min. Journ.-Press* (1926, **121**, 597–604).

Copper Mines in Penghsien, Szechwan. *Min. Journ.* (1926, **153**, 420).

Gold

The Economic Geology of Sabie and Pilgrim's Rest. By W. J. Wybergh. Geol. Surv. Mem. 23, Dept. Mines and Industries, U. of S. Africa. Pp. 124, plates and maps, 9½ × 6. (Pretoria: Government Printing and Stationery Office, 1925.) Price 5*s.* 6*d.*

The Gold Deposits of Nova Scotia. By S. Brunton. *Bull. Can. Inst. Min. Met.* (1926, No. 171, pp. 781–847).

Localisation of Mineral Deposits of Northern Ontario and Quebec. By G. W. Bain. *Canad. Min. Journ.* (1926, **47**, 440–443).

The Whiskey Lake Area (District of Algoma). By G. V. Douglas. Ann. Rept. Ont. Dept. Mines (1925, **34**, Part 4, 34–49 and Geol. map in cover).

District of Patricia, Red Lake and Adjacent Areas. By W. R. Rogers. Bull. 56, Ontario Dept. Mines. Pp. 11, geol. map No. 35e,

Red Lake Gold area in cover, 9½ × 6¼. (Toronto: King's Printer, 1926.)

Gold Mining in Otago, New Zealand. *Chem. Eng. Min. Rev.* (1926, **18**, 269–274).

El Oro y sus Yacimientos en España. By J. Meseguer Pardo. *Revista Minera* (1926, **77**, 320–324, 336–339.)

A Successful Gold Dredging Enterprise in Guatemala. By A. C. Ludlum. *Eng. Min. Journ.-Press* (1926, **121**, 557–559).

Iron

World's Iron-Ore Resources now Exceed 57,000,000,000 Tons. By O. R. Kuhn. *Eng. Min. Journ.* (1926, **122**, 84–93).

Mississagi Reserve and Goulais River Iron Ranges, District of Algoma. By E. S. Moore. *Ann. Rept. Ont. Dept. Mines* (1925, **34**, Part 4, 1–33 and geol. maps in cover).

Genesis of the Magnetite Deposits near the West Coast of Vancouver Island. By W. L. Uglow. *Econ. Geol.* (1926, **21**, 352–363).

Making Sponge Iron in Australia. By P. M. Bonnerup. *Eng. Min. Journ.-Press* (1926, **121**, 889–891).

Die Eisen- und Stahlindustrie Frankreichs im Jahre 1925. *Glückauf* (1926, **62**, 966–972).

Die Eisenwirtschaft Deutschlands im Jahre 1925 und l. Vierteljahr 1926. *Glückauf* (1926, **62**, 773–780, 807–813).

La Industria Minera en Vizcaya (Norte de España). By L. Barreiro. *Internat. Bergwirts.* (1925–26, **1**, 173–176).

Iron-Ore Deposits of Cuba. By O. R. Kuhn. *Eng. Min. Journ.-Press* (1926, **121**, 607–610).

Progress in the Beneficiation of Minnesota Iron Ores. By E. W. Davis. Presented before Iron Ore Session of Assoc. Techn. Societies of Cleveland's Chemical Week Programme, May, 1926. Abstr. *Min. and Met.* (1926, **7**, 280–283).

Informe sobre un Yacimiento de Mineral de Hierro en la Sierra de Paganzo, Provincia de la Rioja. By R. Beder. Publicación No. 12, Dirección General de Minas, Geología e Hidrología. Pp. 9, sketch map and 4 pl., 10½ × 7. (Buenos Aires: Ministerio de Agricultura de la Nación, 1925).

Iron Ores on the West Coast of Chile. By J. Daniels. Paper read before North Pacific Section Amer. Inst. Min. Eng. Abstr. *Min. and Met.* (1926, **7**, 200–206).

Lead and Zinc

Lead and Zinc in Eastern Canada. By F. J. Alcock. *Min. and Met.* (1926, **7**, 51–56).

Mount Albert Map-area, Quebec. By F. J. Alcock. Memoir 144, No. 128, Geol. Series, Geol. Survey, Canada. Pp. 62, index and 6 pl., map in cover, 9½ × 6½. (Ottawa: King's Printer, 1926.) Price 20 cents.

Les Conditions du Développement de l'Électro-Métallurgie du Zinc en Norvège. Traduction par extraits. By A. Sanson. *Rev. de Mét.* (1926, **23**, 126–131).

La Industria del Zinc en Mexico. *Bol. Min.* Mexico (1926, **21**, 125-183 and map of deposits).

Recent Developments in the Aspen District, Colorado. By A. Knopf. Bull. 785-A, U.S. Geol. Surv. Pp. 28 and geol. map, 9 × 6. (Washington: Government Printing Office, 1926.)

Selective Lead-Zinc Flotation at Sunnyside. By E. H. Robie. *Eng. Min. Journ.-Press* (1926, **121**, 757–762).

Platinum

Platinum in the Transvaal and Elsewhere. By A. W. Newberry and J. F. Kemp. *Eng. Min. Journ.-Press* (1926, **121**, 717–725, 763–768).

Occurrence of the Platinum Metals in South Africa. By P. A. Wagner. *Econ. Geol.* (1926, **21**, 109–134, 243–270).

The Economic History of Platinum. By P. Kovaloff. *S. African Min. Eng. Journ.* (1926, **37**, 113–116, 137–139).

The Platinum Market in the Near Future. By P. Kovaloff. *S. African Min. Eng. Journ.* (1926, **37**, 615–619, 641–645).

Quicksilver

The Quicksilver Situation from a Domestic Standpoint. By J. W. Furness and R. M. Santmyers. Information Circular 6007, U.S. Bur. Mines. Pp. 13, charts and map, 10½ × 8. (Washington: Bureau of Mines, 1926.)

Silver

Forma en que se produce la Plata en la República, Procedencia de ella y Destino que se le da. *Bol. Min. Mexico* (1926, **21**, 209–211).

Tin

Modernising Tin Concentration Practice in Bolivia. By R. D. Ferron. *Eng. Min. Journ.-Press* (1926, **121**, 1043–1045).

Geologic Features of Bolivia's Tin-Bearing Veins. By F. R. Koeberlin. *Eng. Min. Journ.-Press* (1926, **121**, 636–642).

Replacement in the Tin-bearing Veins of Caracoles, Bolivia. By W. Lindgren. *Econ. Geol.* (1926, **21**, 135–144).

Tungsten

Mining Tungsten at Pine Creek. By G. J. Young. *Eng. Min. Journ.-Press* (1926, **121**, 605–606).

Vanadium

Les Ressources Minérales Mondiales (Monographies relatives aux différents Métaux): Le Vanadium. By M. Fourment. *Rev. de Mét.* (1926, **23**, 132–142).

NON-METALS

Cement

Un Ciment Hydraulique Réfractaire. By J. Arnould. *Chim. et Ind.* (1926, **15**, 184–188).

High-Alumina Hydraulic Cements. By P. H. Bates. *Ind. Eng. Chem.* (1926, **18**, 554–559).

Les Ciments Ferreux et Alumineux et Quelques Considérations sur les Composés Hydrauliques. By E. Martin. *Le Moniteur Scient.* (1926, **16**, 97–101).

Clay

The Lough Neagh Clays. By W. B. Wright. *Trans. Ceram. Soc.* (1925–26, **25**, 171–183).

Coal

The Economics of the Coal Industry. By F. Hodges. *Journ. Roy. Soc. Arts* (1926, **74**, 845–858 with discussion).

Investigations of Fuels and Fuel Testing, 1924. *No.* 644, *Mines Branch, Canada.* Pp. 81, 9½ × 6½. (Ottawa: King's Printer, 1926.)

The Report of the Alberta Coal Commission, 1925: a Critical Analysis and some Constructive Suggestions. By J. A. H. Church. *Bull. Can. Inst. Min. Met.* (1926, No. 171, pp. 848–873).

The Western Coalfield of New South Wales. By H. G. Raggatt.

Lecturette at the Mining Museum, Sydney, March 17, 1926. Abstr. *Chem. Eng. Min. Rev.* (1926, **18**, 319–321).

Reconstitution des Mines françaises. By P. A. Guerre. *Ann. des Mines de Roumanie* (1926, **9**, 203–209).

La Situation du Bassin Houiller du Nord en 1924: Report by Leprince-Ringuet. Abstr. in *Ann. des Mines*, Paris (1926, **9**, 130–138).

Les Résultats et les Nouveautés de l'Exploitation Houillère dans le Nord en 1925. By Stouvenot. *Rev. de l'Ind. Min.* (1926, No. 132, Part I, pp. 279–282).

La Situation de l'Industrie Houillère et Métallurgique en France au début de l'année 1926. By V. Truant. *Internat. Bergwirts.* (1925–1926, **1**, 192–196).

La Neutralisation des Poussières dans les Houillères de la Ruhr. Rapport présenté à la Commission Permanente des Recherches Scientifiques. By E. Audibert and L. Delmas. *Ann. des Mines, Paris* (1926, **9**, Series 12, No. 5, 241–264).

Die Kohlenwirtschaft Griechenlands. By P. Giannelia. *Montan. Runds.* (1926, **18**, 386–390).

Die Steinkohlenlager in Holland und deren Ausbeutung. By P. Tesch. *Internat. Bergwirts.* (1925–26, **1**, 176–182).

The Coal Deposits and Coal Mining of Svalbard (Spitsbergen and Bear Island). By A. Hoel. Resultater a.d. Norske-Spitsbergen-ekspeditionen. (Oslo, 1925, **1**, No. 6, 92 pp. 8 pl.). Abstr. *Zeits. f. prakt. Geologie* (1926, **34**, 63).

Notes on a Few New American Underground Cutting, Loading and Conveying-Machines. By R. K. Jeffrey. *Trans. Inst. Min. Eng.* (1926, **71** Part 3, 407–416).

L'Industrie et le Commerce des Charbons en Chine pendant l'année 1924. *Bull. Quotidien de la Soc. d'Etudes et d'Informations écon.* (1925, Dec. 8). Abstr. *Rev. de l'Ind. Min.* (1926, No. 134, Part 3, pp. 259–264).

Die Verschwelung von Kohlenstaub. By A. Thau. *Glückauf* (1926, **62**, 896–901).

Report on the Examination of Burmese Lignites from Namma, Lashio and Pauk. By C. H. Lander, with an Introduction by F. W. Walker. *Rec. Geol. Survey India* (1926, **56**, 362–383).

A Contribution to the Study of the Coking of Coals and a proposed Standard Method for the Determination of the Agglutinating Value of Coal. By M. Barash. *Chemistry and Industry* (1926, **45**, 151T–160T).

Les Récents Progrès réalisés dans la Construction et l'Exploitation des Fours à Coke. By C. Berthelot. *Bull. de la Soc. d'Encour. pour l'Ind. Nat.* (1926, **125**, 145–183).

The Cause of Coking in Coals. By R. Quarendon. *Chemistry and Industry* (1926, **45**, 468–470, 483–487).

Torfvergasung und Torfverkokung. By G. Keppeler. *Stahl u. Eisen* (1926, **46**, 631–635, 742–750).

Low-Temperature Carbonisation. By D. Brownlie. Paper before South Wales Inst. Eng., April 22, 1926. Abstr. in part in *Iron and Coal Tr. Rev.* (1926, **112**, 690).

The Origin of Carbon Disulfide in the Carbonisation of Coal. By W. J. Huff. *Ind. Eng. Chem.* (1926, **18**, 357–361).

Recherches entreprises aux Mines de la Sarre sur la Carbonisation à Basse Température. By J. Sainte-Claire Deville. *Chim. et Ind.* (1926, **15**, 163–172).

La Carbonisation des Combustibles Solides à Basse Température. By H. Verdinne. *Ann. des Mines de Belgique* (1926, **27**, 135–157).

Épuration liquide du Gaz de Houille et Récupération du Soufre. By C. Harnist. *Chim. et Ind.* (1926, **15**, 506–513).

Diamonds

Diamond Mining in 1925. By S. H. Ball. *Eng. Min. Journ.-Press* (1926, **121**, 925–927).

Graphite

Note on the Origin of the Graphite Veins of Ceylon. By F. D. Adams. *Bull. Can. Inst. Min. and Met.* (1926, No. 168, pp. 496–503).

The Rôle of Graphite in Lubrication. By F. L. Koethen. *Ind. Eng. Chem.* (1926, **18**, 497–499).

Limestone

Manitoba Limestone from the Tyndall Area. By H. B. Lumsden. *Bull. Can. Inst. Min. and Met.* (1926, No. 168, pp. 504–518).

Lithium

Mining Lepidolite in New Mexico. By A. Roos. *Eng. Min. Journ.-Press* (1926, **121**, 1037–1042).

Nitrates

The Chilean Nitrate Industry. By B. Diaz Ossa. *Internat. Inst. Agric.* (1925, **3**, 942–971).

Genesis of Chilean Nitrate. By J. E. Harding. *Eng. Min. Journ.-Press* (1926, **121**, 885–888).

L'impianto di Merano per la fabbricazione dell' ammoniaca sintetica. By A. Coppadoro. *Giorn. Chim. Ind. ed Appl.* (1926, **8**, 248–256).

Petroleum and Allied Products

Digest of the Results of the Enquiries made concerning the Occurrence of Petroleum and of Pitch in the Colony. By J. B. Harrison. *British Guiana Combined Court Paper* No. 37. Printed in Continuation of Sessional Paper No. 922 of 1917. Pp. 19, 13 × 8. (Georgetown, Demerara: Printers to the Government of British Guiana, 1925.)

Investigations of Fuels and Fuel Testing, 1924. No. 644, Mines Branch, Canada. Pp. 81, 9½ × 6½. (Ottawa: King's Printer, 1926.)

Oil and Gas Prospects of the Wainwright-Vermilion Area, Alberta. By G. S. Hume. *Summary Rept.* 1924, *Part B, Geol. Survey Canada.* Pp. 1–22, 9½ × 6½, map in cover. (Ottawa: 1926.)

Petroleum and Natural Gas Development in Alberta. By C. C. Ross. *Bull. Can. Inst. Min. and Met.* (1926, No. 168, pp. 466–495).

The Search for Oil in Australia. By A. Wade. *Journ. Inst. Petr. Techn.* (1926, **12**, 145–172 with discussion).

The Search for Oil in South-Western Queensland. By L. C. Ball. *Q. Govt. Min. Journ.* (1926, **27**, 155–166).

Rückblick auf die deutsche Erdöl-Produktion und Bohrtätigkeit im Jahre 1925. *Internat. Bergwirts.* (1925–26, **1**, 196–198).

The Oil-Refining Industry of Poland. By S. Bartoszewicz. *Petr. Times* (1926, **15**, 733–734).

La Formation des Gisements de Pétrole en Roumanie. By G. Macovei. *Ann. des Mines de Roumanie* (1926, **9**, 243–253 and geological map).

Report on Boring for Oil in Egypt. By T. S. Bowman. Section 2–Sinai. Pp. 91, 17 photographs, 10½ × 7. (Cairo: Government Press, 1926.) Price, P.T. 10.

El Presente y el Futuro de la Industria Petrolera Mexicana. By S. G. Cordero and P. Rubio. Paper presented to the Internat. Petroleum Congress, Tulsa, Okla. *Bol. Petr.* México (1926, **21**, 293–316).

Petroleum and Natural Gas in Montana. By J. P. Rowe. *Eng. Min. Journ.-Press* (1926, **121**, 563–568).

The Oilfields of the Maracaibo Basin. By C. M. Hunter. *Journ. Inst. Petr. Techn.* (1926, **12**, 235–256).

The Physical and Chemical Properties of Paraffin Wax, particularly in the Solid State. By J. A. Carpenter. *Journ. Inst. Petr. Techn.* (1926, **12**, 288–315).

The Sulphur Compounds of Kimmeridge Shale Oil. By F. Challenger, J. Haslam, R. J. Bramhall and J. Walkden. *Journ. Inst. Petr. Techn.* (1926, **12**, 106–141 with bibliography and discussion).

Synthetic Fuel from Carbon Monoxide and Hydrogen. By O. C. Elvins and A. W. Nash. *Fuel in Science and Practice* (1926, **5**, 263–265).

Phosphates

Marine Phosphatic Horizons in the Tertiary Limestones and Greensands of South Canterbury and North Otago, and Brachiopod Evidence as to their Age. By J. A. Thomson. Paper before Wellington Philosophical Soc., Sept. 9, 1925. *N. Zeal. Journ. Sci. Techn.* (1926, **8**, 143–160 with bibliography).

Der Obolensandstein, ein estländisches Rohphosphat. By C. Gäbert. *Zeits. f. prakt. Geologie* (1926, **34**, 67–72).

Phosphates et Guanos Phosphatés. By J. Duclos. *Bull. des Mines de Madagascar* (1926, No. 40, pp. 60–64, production table and map of Madagascar deposits).

Potash

Bericht des Deutschen Kalivereins in Berlin über das Geschäftsjahr 1925. *Glückauf* (1926, **62**, 645–647).

Refractories

Engineering Principles Applied to Exploitation of a Clay Deposit. By C. N. Schuette. *Eng. Min. Journ.-Press* (1926, **121**, 964–968).

The Use of Silica Refractories. By P. B. Robinson. *Chemistry and Industry* (1926, **45**, 29T–33T).

Some Experiments upon the Development of Sillimanite Refractories for Glass-Making. By W. A. McIntyre. *Journ. Soc. Glass Techn.* (1926, **10**, 73–80).

Un Ciment hydraulique Réfractaire. By T. Arnould. *Chim. et Ind.* (1926, **15**, 184–188).

Salt

The Maurypur Salt Works. By J. A. Dunn. *Rec. Geol. Surv. India* (1925, **56**, 384–386).

The Andean Salares. By J. E. Harding. *Eng. Min. Journ.-Press* (1926, **121**, 797–800).

Uranium (Radium) Minerals

Uranpecherz in Nordkarelien. By A. Labuncev. *Bergjournal,* (1925, No. 10). Abstr. *Zeits. f. prakt. Geologie* (1926, **34**, 61–62).

General Geology of the Katanga Radium Deposits. By H. W. Turner. *Mining Mag.* (1926, **34**, 220–223).

NOTICES OF RECENT LITERATURE

THE OIL INDUSTRY: PRODUCTION, TRANSPORTATION, RESOURCES, REFINING, MARKETING. By Ernest Raymond Lilley, Sc.D. Pp. x + 547, 9½ × 6¼. (London: Constable & Co., Ltd., 1926.) Price 31*s.* 6*d.*

The author, who is Assistant Professor of Geology at New York University, has produced a very useful book,

adequately fulfilling its purpose, viz.—to assist the individual worker in the oil industry to understand his relationship to his fellow workers. The industry has grown to such large dimensions, and the various branches of it have become so specialised, that it is hardly possible for one man to be familiar with the problems constantly arising in all branches, or the methods by which they are being solved.

Naturally, the book deals principally with conditions and practice in the United States, but the resources and leasing systems of the other important producing countries are dealt with briefly. The oil consumption of the United States has increased sevenfold during the past 20 years, while the price of crude oil in the same time has almost doubled. Whereas formerly the principal refinery product was kerosene, this is now of minor importance and gasoline is the dominating factor in value. The increase of motor traction is, of course, responsible for this, and the demand has been met by increased use of "cracking" processes in the refineries. As the demand for gasoline is certain to grow rapidly in future, it is comforting to know that only a small part of the oil refined is at present subjected to this process and that much greater quantities can be produced when required. The total number of motor vehicles in the world at the beginning of 1925 was estimated at 21,360,779, of which 17,726,507 were in the United States. These figures show clearly the enormous demand for gasoline that may be expected as motor traction develops in Europe.

The book is well balanced and gives an excellent perspective of the whole industry, the principal subjects being denoted by the title. To the outsider the last three chapters may be the most interesting, dealing with world corporation control, competitive and substitute industries, and outlook. Each of the thirteen chapters has a short bibliography. The book is well printed and illustrated, and is provided with a useful index.

THE COLLIERY YEAR BOOK AND COAL TRADES DIRECTORY, 1926. Pp. 1024, $8\frac{3}{4} \times 6$. (London: The Louis Cassier Company, Ltd., 1926.) Price 21*s*.

In view of the widespread interest taken in the present coal situation in Great Britain the issue of the fourth annual edition of this publication is very opportune, as it is not only a very complete guide to the economics of the coal industry, but contains a large amount of other information, and is, in fact, a very complete book of reference. It contains useful abstracts of the evidence

given before the Royal Coal Commission (1925) and the Commission's summary of its findings. In other sections are given lists of the colliery companies, with condensed information on the localities, seams worked and classes of coal mined, a list of coal mines, the Coal Mines Regulations, statistical tables, notes on the preparation of coal for the market, lists of coke makers with the by-products produced, gas and electricity undertakings, merchants, etc. In addition there are lists of the personnel of the Mines Department, various Research Boards, the Mining Association, the Miners' Federation, various Trade Unions, and professional associations.

THE RUHR-LORRAINE INDUSTRIAL PROBLEM. By Guy Greer. Pp. xx + 328, $7\frac{3}{4} \times 5\frac{1}{4}$. (London: George Allen & Unwin, Ltd., 1925.) Price 8*s*. 6*d*.

This book by an American author is issued as one of a series by the Institute of Economics of New York, which claims as its sole object to ascertain the facts about current economic problems and to interpret those facts for the people of the United States. It is well worth a careful study by the people of Great Britain at the present time, as it deals with a small but very competitive area in one of the most highly industrialised parts of continental Europe. The area in question, roughly triangular in shape, comprising Western Germany, Northern France, Belgium and Luxemburg, includes the coalfields of the Ruhr, Holland, Belgium and North-West France, and in the south-east part, the Lorraine iron deposits and the Saar coalfield. By far the most important of these are the Lorraine iron deposits and the Ruhr coal deposits. The ores of the former, known as "minette" ores, are of low grade, but are estimated to contain 1,608 million tons of iron, while the Ruhr contains enough coking coal to smelt this amount 40 times over.

The author deals exhaustively with the whole area as one economic unit and with the international nature of the industries. He also fully examines the coal and iron situation under the peace treaties, the occupation of the Ruhr and the future of the Ruhr-Lorraine system. There are some useful appendices in the book and a map of the industrial region.

THE AMERICAN YEAR BOOK. A RECORD OF EVENTS AND PROGRESS, YEAR 1925. Editor: Albert Bushnell Hart, LL.D., Associate Editor: William M. Schuyler. Edited with the co-operation of a Supervisory Board

Representing National Learned Societies. Pp. xxxv + 1158, 8 × 5½ (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1926.) Price 31*s*. 6*d*.

This volume marks a resumption of publication after the lapse of five years, the New York Times Company having made this possible by providing the necessary funds. The book is intended to be a conspectus of progress in the United States during the year, but it deals with important events and developments covering a far wider field. From the list of 256 contributors and 45 societies represented on the Supervisory Board, the authoritative nature of the large amount of information given in these 1158 pages is clear. The work contains 40 divisions, each of which is further subdivided, and all come under one of the seven main parts which are:—Historical, American Government, Governmental Functions, Economics and Business, Social Conditions and Aims, Science, and The Humanities. Mineral industries form a division of the part dealing with economics and business, while geology, meteorology and geography form a division of the Science section. Electro-chemistry, industrial chemistry and chemical engineering are subdivisions of chemistry and physics. The foregoing subjects, as far as they are of special interest to those engaged in the mineral industry, occupy about 52 pages of the whole work, but there is much more of general interest to the student of science.

The style is varied, as one would expect in a work with so many contributors, and some expressions are rather puzzling to an English reader, as, for example, the description of the industrial areas of Lancashire and Yorkshire as "the great manufacturing conurbation axially disposed about the Pennines." In the subsection on copper the cost of steam-shovel operation is given as $3.50 to $4.50 per cubic yard. Two pages farther on it is stated that the Katanga district is in South Africa and belongs to the Rhodesian Border Concessions. Almost immediately following this is the statement that high-grade electrolytic copper is shipped from Arizona directly to an Eastern refinery. In the chapter on lead the author commits himself to the questionable view that the price of lead is now definitely established above the price of zinc.

The division dealing with organisation and control of business is of general interest, especially in view of the controversies that have arisen in connection with coffee and rubber. The power of the enormous stocks of gold accumulated by the United States is stated to transcend in importance any monopolies of raw materials that have

yet been established, and in this connection the following paragraph is worth quoting: "Our government officials have been among the first to realise the importance of this situation, and last year began to wield this power for the purpose of coercing foreign countries. This control is entirely without legal sanction and has been effected through a sort of moral pressure from Washington to inhibit foreign loans to countries which we desired to bring to terms."

The book contains much useful information with reference to the mineral industry, and includes much that it is well worth while to put on record concerning recent progress, especially in the United States.

THE PETROLOGY OF THE IGNEOUS ROCKS. By F. H. Hatch. Eighth edition, revised with the assistance of A. K. Wells. Pp. xxiv + 566, $7\frac{1}{2} \times 5\frac{1}{4}$. (London: George Allen & Unwin, Ltd.; New York: The Macmillan Company, 1926.) Price 15*s*.

The eighth edition of Hatch's *Petrology of the Igneous Rocks* has been very substantially revised and amplified. The seventh edition had 436 pages. The new features in the present edition include chapters on the consolidation of igneous magmas, cycles of igneous activity in the British Isles, and references to much recent original work, including that of the Geophysical Laboratory at Washington. The new matter is presented in simple style, without any elaboration of the controversial elements that much of it involves. Careful judgment has been exercised in the difficult matter of nomenclature, and the text is pleasantly free from those numerous unattractive rock-names, the multiplication of which has been one of the least commendable of the activities of petrographers. For those who wish to have a list of rock names, many of which are very properly regarded by the authors as not deserving a place in the text, provision has been made in a useful special index of rock names, definitions being given in the index to those names not otherwise mentioned. A general index and an index of localities are also provided. The present edition is in no way behind its predecessors as an effort to present the subject matter of igneous petrology in a simple and attractive way, a characteristic that has marked all previous editions, and one that explains the popularity that this book has always maintained among students.

MONTHLY
MINERAL AND METAL STATISTICS.

JANUARY—JUNE, 1926.

Owing to lack of space, only the more important monthly statistics relating to the production of and trade in the principal minerals and metals can be included in the following pages. Anyone requiring further information on these or other minerals and metals should communicate with the Director, Imperial Institute, South Kensington, London, S.W.7.

Where the descriptions " Imports " and " Exports " are used without qualification in the following pages, " Imports " is equivalent to " Imports for home consumption," while " Exports " represents " Exports of domestic produce."

A blank space in the columns indicates that information has not yet been received, whereas a dash indicates that, so far as can be ascertained, no production or trade took place.

The units of quantity adopted for these returns are the British statute hundredweight and ton of 112 lb. (avdp.) and 2,240 lb. (avdp.) respectively, the imperial gallon and the metric carat. For precious metals the troy ounce has been used.

In those cases where values expressed in pounds sterling are given in place of quantities, the original values have been converted to pounds sterling at average rates of exchange with the exception of those for the Union of South Africa, Australia and New Zealand, in which cases the original currency values are given.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
ALUMINIUM								
BRITISH EMPIRE								
United Kingdom:								
Exports of ingots, blocks, etc.	Long ton	3,717	496	433	258	399	182	263
Canada:								
Imports of cryolite . .	Long ton	673	60	9	79	22	25	343
Imports of alumina . .	do.	56,922	5,403	5,705	7,586	3,831	3,689	5,916
Exports of blocks, bars, etc. .	do.	16,637	1,249	1,006	837	546	479	707
British Guiana:								
Production of bauxite . .	Long ton	194,339						
Exports of bauxite . .	do.	174,999	6,634	15,049	13,034	25,678	15,980	21,695
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.:								
Imports of bauxite . .	Long ton	3,542	251	114	161	10	58	193
Imports of crude aluminium and scrap	do.	990	54	52	75	28	52	99
Czechoslovakia:								
Imports of cryolite . .	Long ton	909	25	50	55	75	70	25
Imports of sheets, plates, etc.	do.	182	11	28	11	8	8	39
France:								
Production of bauxite . .	Long ton	400,001	31,917	30,300	41,496	37 980	32,735	
Exports of bauxite, etc. . .	do.	211,510	14,508	14,028	9,250	21,133	20,105	24,873
Exports of anhydrous alumina	do.	21,188	3,109	327	1,521	1,466	2,416	1,499
Exports of hydrate of alumina	do.	3,774	4	102	183	3	94	2
Production of aluminium .	do.	21,000						
Exports of ingots, scrap and wrought aluminium . .	do.	3,244	224	129	83	68	101	148
Germany:								
Exports of crude bauxite and natural cryolite . . .	Long ton	469	—	5	—	—	—	—
Production of aluminium .	do.	25,000						
Exports of crude, scrap and wrought aluminium . .	do	7,489	2,601	1,673	1,488	2,313	990	1,094

Imports of crude, scrap and wrought aluminium . .	do.	10,734	444	295	251	246	253	343
Italy :								
Production of bauxite . .	Long ton	192,000						
Production of aluminium .	do.	1,850						
Imports of ingots, etc., sheets, bars and tubes . . .	do.	6,579	422	245	201	451	337	487
Norway :								
Total imports of bauxite .	£	284,202	3,103	771	59,678	16,949	73,490	42,560
Total imports of cryolite .	£	75,994	454	5,751	4,173	3,912	11,495	6,749
Total imports of alumina .	£	513,258	55,497	28,442	22,637	110,966	41,947	93,862
Exports of ingots and sheets .	Long ton	20,319	1,806	1,123	2,528	1,713	1,907	2,288
Switzerland :								
Exports of blocks, etc., scrap, sheets, tubes, and wire, including some alloys . .	Long ton	15,639	760	818	947	1,029	1,490	1,718
United States :								
Production of bauxite . .	Long ton	316,540						
Total imports of crude bauxite	do.	353,696	7,312	23,122	18,938	42,869	25,976	34,178
Total imports of cryolite .	do.	9,844	—	—	—	34	27	12
Exports of bauxite, etc. .	do.	78,570	4,408	4,359	14,416	3,934	9,353	6,152
Total imports of ingots, scrap and alloys, plates and sheets, etc.	do.	19,425	3,150	3,404	2,403	3,479	2,669	2,162
Exports of ingots, scrap and alloys, plates and sheets, etc.	do.	5,644	123	190	381	57	284	274
Dutch Guiana :								
Exports of bauxite . .	Long ton	84,150						
ASBESTOS								
BRITISH EMPIRE								
United Kingdom :								
Total imports of raw asbestos, fibre and waste, including asbestic :	Long ton	26,118	1,731	1,203	2,882	2,377	1,297	3,083
Re-exports of raw asbestos, fibre and waste, including asbestic	do.	5,580	214	114	255	250	168	322

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
ASBESTOS (*contd.*)								
Southern Rhodesia :								
Production of asbestos . .	Long ton	30,669	2,279	1,934	2,311	2,909	3,177	2,865
Exports of asbestos . .	do.	30,107	1,457	1,558	1,863			
Union of South Africa :								
Sales and shipments in Transvaal	Long ton	6,810	407	786	917	1,124	301	1,059
Sales and shipments in Cape of Good Hope . . .	do.	2,268	210	266	228	288	322	386
Exports from Union of raw asbestos	do.	5,922	192	523	728			
Canada :								
Production of asbestos . .	Long ton	251,485						
Exports of asbestos . .	do.	122,098	9,985	9,090	9,463	7,949	7,465	17,246
Exports of asbestos sand (i.e. short fibre) and waste .	do.	108,274	11,567	9,568	11,681	7,979	8,130	7,420
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports of raw asbestos and fibre	Long ton	10,663	2,319	742	1,328	1,114	1,752	2,730
Exports of raw asbestos and fibre	do.	246	59	21	3	47	18	21
Germany :								
Imports of raw asbestos and fibre	Long ton	11,965	546	371	514	443	319	617
Italy :								
Production of asbestos . .	Long ton	2,071						
Imports of asbestos . .	do.	6,338	204	302	149	614	322	705
Exports of asbestos . .	do.	921	143	83	57	142	70	76
Netherlands :								
Imports of asbestos . .	Long ton	1,286	45	260	37	29	212	41

Russia :							
Production of asbestos rock .	Long ton		12,418	17,805	15,544	5,967	
Production of assorted asbestos	do.	(b)10,000	1,050	1,273	1,045	1,656	
United States :							
Total imports of unmanufactured asbestos . . .	Long ton	205,821	18,374	18,482	21,876	23,404	16,194
BARIUM MINERALS							
BRITISH EMPIRE							
United Kingdom :							
Production of unground barytes and witherite in Great Britain	Long ton	36,336	(c)1,994	(c)1,994	(c)1,994		
Production of ground barytes and witherite in Great Britain	do.	12,345	(c)1,381	(c)1,381	(c)1,381		
Total imports of ground barytes (a)	do.	42,620	2,669	3,597	3,374	3,005	2,933
Exports of ground barytes (a)	do.	3,378	295	42	32	771	23
Southern Rhodesia :							
Production of barytes .	Long ton	36	—	—	—	21	—
Canada :							
Imports of barytes . .	Long ton	2,173	120	144	187	178	141
Australia (Tasmania) :							
Production of barytes . .	Long ton	4	—	—	—	—	—
FOREIGN COUNTRIES							
Czechoslovakia :							
Imports of crude barytes .	Long ton	3,782	98	394	315	625	311
Imports of ground barytes .	do.	3,445	35	445	283	149	255

(a) *Including precipitated barium sulphate.* (b) *Year ended* 30*th September*, 1925. (c) *Monthly average of first quarter*, 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
BARIUM MINERALS (*contd.*)								
France :								
Imports of barytes	Long ton	8,557	739	597	1,612	923	988	518
Exports of barytes	do.	1,563	125	162	83	156	154	154
Imports of witherite	do.	1,273	—	20	110	50	100	—
Germany :								
Exports of barytes and celestite	Long ton	165,609	8,726	11,545	12,150	11,914	11,059	13,910
Imports of barytes and celestite	do.	2,301	201	—	217	—	—	—
Italy :								
Production of barytes	Long ton	31,678						
Netherlands :								
Imports of barytes	Long ton	52,360	2,705	2,336	2,633	2,482	1,915	2,364
Russia :								
Production of barytes	Long ton		121	122	157	249		
CADMIUM								
Australia :								
Cadmium content of ore produced in Tasmania	Lb.	11,750	(*a*)1,062	(*a*)1,062	(*a*)1,062	(*c*)837	(*c*)837	(*c*)837
Cadmium produced in Tasmania from other than Tasmanian ores	do.	388,911	(*a*)34,330	(*a*)34,330	(*a*)34,330	(*c*)26,748	(*c*)26,748	(*c*)26,748
Exports overseas of cadmium from :								
New South Wales	do.	71,456	—	—	35,840	39,760	—	—
Victoria	do.	219,520	35,840	53,760	—	—	—	25,760
Tasmania	do.	156,324	5,264	—	—	—	27,664	12,096
France :								
Imports of cadmium	Lb.	171,471	12,783	13,224	3,086	—	30,415	22,481
CHINA CLAY								
EXPORTS FROM BRITISH EMPIRE								
United Kingdom (including Cornish or china stone)	Long ton	652,576	48,531	49,867	55,507	44,952	54,377	63,924

Exports from Foreign Countries								
Belgium-Luxemburg E.U.	Long ton	7,085	118	109	442	225	311	429
Czechoslovakia	Long ton	236,280	15,336	15,694	16,443	18,652	18,074	19,123
Denmark	Long ton	4,136	—	—	—	—	422	—
France	Long ton	5,209	469	280	1,599	399	629	528
Germany	Long ton	28,455	2,263	2,300	3,195	2,298	3,026	2,458
Russia (production)	Long ton		5,369	2,963	4,084	7,928		
Imports into British Empire								
Canada	Long ton	16,245	706	844	1,259	1,215	975	1,724
India (total imports from over-seas)	Long ton	24,531	1,898	1,413	1,628	2,854	2,275	2,104
Imports into Foreign Countries								
Belgium-Luxemburg E.U.	Long ton	42,535	3,670	5,522	5,649	4,344	4,260	12,925
Czechoslovakia	Long ton	2,291	156	233	157	154	168	168
Denmark	Long ton	5,310	569	387	161	636	82	391
France	Long ton	54,737	3,450	5,878	5,601	5,968	4,968	4,582
Germany	Long ton	223,022	11,939	18,304	14,092	17,962	15,311	16,185
Italy	Long ton	39,931	1,916	5,317	3,534	3,007	3,665	2,537
Netherlands	Long ton	46,871	2,866	2,994	3,598	3,574	3,964	6,802
United States (total imports)	Long ton	332,622	24,295	17,301	56,050	17,601	35,750	23,312
CHROME ORE								
British Empire								
Southern Rhodesia:								
Production	Long ton	121,274	11,654	7,748	8,970	4,631	12,417	14,061
Exports	do.	129,866	8,509	12,160	5,170			
Union of South Africa:								
Sales and shipments	Long ton	11,137	541	229	1,052	1,505	1,584	3,443
Exports from Union	do.	5,933	98	(b)	—			

(a) *Monthly average of first quarter, 1926.* (b) *Less than ½ ton.* (c) *Monthly average of second quarter, 1926.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
CHROME ORE								
India :								
Exports overseas	Long ton	36,157	2,850	4,295	4,300	7,600	2,390	1,100
FOREIGN COUNTRIES								
Czechoslovakia :								
Imports	Long ton	1,535	130	103	187	433	209	125
Germany :								
Imports	Long ton	25,468	1,274	1,480	2,883	2,888	1 ,137	772
Norway :								
Total imports of chrome ore	£	35,037	2,517	—	3,728	6,125	—	—
Exports of ferro-chrome	Long ton	2,486	119	289	254	175	49	63
Russia :								
Production	Long ton		2,225	1,748	1,731	759		
Cuba :								
Production	Long ton	11,655						
United States :								
Total imports	Long ton	149,739	11,040	15,357	17,000	22,532	14,409	8,661
New Caledonia :								
Exports	Long ton	18,208						
COAL								
PRODUCTION OF COAL IN BRITISH EMPIRE								
Great Britain	Long ton	244,418,400	21,591,800	21,314,300	23,852,200	21,567,600		
Southern Rhodesia	Long ton	678,320	66,716	62,481	61,866	60,022	67,720	75,411
Union of South Africa (*a*)	Long ton	13,582,451	902,959	938,754	1,022,272	988,426	1,072,738	1,084,378
Canada :								
Bituminous coal	Long ton	7,980,340	697,323	628,858	744,566	740,427	927,191	1,146,351
Sub-bituminous coal	do.	509,477	57,049	45,824	35,210	[illegible]8,736	18,897	8,408
Lignite	do.	3,232,862	338,171	279,054	171,618	122,529	72,331	83,670
India (*b*)	Long ton	19,969,041	1,783,308	2,066,960	1,983,338	1,776,104	1,643,846	1,597,300

Australia :								
New South Wales . . .	Long ton	11,396,199						
Western Australia (c) . .	do.	37,511	2,983	3,752	6,429	1,208	1,354	7,300
Tasmania	do.	81,698	(d)6,670	(d)6,670	(d)6,670	(f)8,907	(f)8,907	(f)8,907
PRODUCTION OF COAL IN FOREIGN COUNTRIES								
Austria :								
Coal	Long ton	142,866	14,335	12,500	13,290	13,185	14,670	11,904
Brown coal	do.	2,984,627	286,969	245,180	272,634	216,127	212,242	209,009
Belgium	Long ton	22,761,377	1,944,558	1,864,023	2,098,611	1,952,114	1,816,765	2,066,811
Czechoslovakia :								
Coal	Long ton	12,549,474	1,183,505	1,017,240	1,060,330	921,056	886,000	962,505
Brown coal	do.	18,487,130	1,616,320	1,498,605	1,602,209	1,445,041	1,313,000	1,321,070
France :								
Coal produced in Saar . .	Long ton	12,781,084	1,094,776	1,084,360	1,246,516	1,055,003	1,037,779	1,076,666
Coal produced in other districts	do.	46,291,507	4,093,991	3,941,031	4,400,459	4,049,717	3,803,921	4,275,152
Brown coal	do.	991,082	88,901	81,438	92,179	83,001	74,851	83,633
Germany (excluding Saar) :								
Coal	Long ton	130,595,951	11,010,165	10,440,686	11,240,674	9,923,847	10,506,595	11,567,444
Brown coal	do.	137,543,093	12,025,613	10,936,745	11,644,709	9,905,636	9,734,962	11,022,446
Hungary :								
Coal	Long ton	6,100,000	(e)62,610	(e)62,610	68,833	62,905	59,259	62,303
Brown coal	do.		(e)462,567	(e)462,567	439,815	352,211	343,658	374,524
Italy :								
Anthracite	Long ton	14,072						
Bituminous coal . . .	do.	171,420						
Brown coal	do.	1,087,707						
Netherlands (excluding brown coal)	Long ton	6,738,501	621,000	582,000	695,000	654,000	656,000	712,000
Poland (excluding brown coal) .	Long ton	28,613,134	2,417,000	2,108,000	2,258,000	2,147,290	2,199,009	2,618,005

(a) *Quantity of coal mined less waste sorted.* (b) *Excluding Indian States.*
(c) *Exports from the State, not necessarily overseas, and including bunkers.*
(d) *Monthly average of first quarter, 1926.* (e) *Monthly average of January and February.*
(f) *Monthly average of second quarter, 1926.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
COAL (*contd.*)								
Russia	Long ton	17,398,000	1,993,000	2,082,000	2,230,000	2,127,000	1,806,000	1,960,000
Spain	Long ton	6,151,112						
Algeria	Long ton	9,869	—	758	893			
Belgian Congo	Long ton	80,000						
Mexico	Long ton		74,299	73,655	70,455	78,243	74,626	74,704
United States:								
Anthracite	Long ton	55,193,883	154,000	1,860,000	7,848,000	7,337,000	7,191,000	7,979,000
Bituminous coal	do.	466,935,000	47,912,000	41,587,000	41,194,000	35,785,000	34,874,000	37,493,000
Chile	Long ton	1,417,275	93,170	112,914	119,295	110,484	116,120	120,662
French Indo-China (exports)	Long ton	690,181	60,721	23,089	93,162			
Japan	Long ton	29,000,000						
COBALT								
BRITISH EMPIRE								
Canada:								
Ontario:								
Production of metal	Cwt.	2,693	(*a*)100	(*a*)100	(*a*)100			
Production of oxide	do.	5,139	(*a*)311	(*a*)311	(*a*)311	(*d*)150	(*d*)150	(*d*)150
Dominion:								
Exports of metal	do.	2,616	183	157	61	126	173	138
Exports of oxide and salts	do.	7,794	424	248	494	123	191	192
Australia (Queensland):								
Production of concentrates	Cwt.	1,800	(*a*)113	(*a*)113	(*a*)113	(*d*)7	(*d*)7	(*d*)7
Exports of ore overseas	do.	11,884	146	—	—	1,651	1,060	—
FOREIGN COUNTRIES								
France:								
Imports of oxide	Cwt.	3,237	242	98	328	2	—	—
Exports of ore	do.	1,035	—	—	—	—	—	—
United States:								
Total imports of ore and metal	Cwt.	1,878	25	271	345	350	130	305
Total imports of oxide	do.	2,565	967	331	258	219	163	241

22*

COPPER								
BRITISH EMPIRE								
United Kingdom:								
Total imports of ore, regulus, matte, cement-copper and scale	Long ton	36,730	1,555	50	7,303	2,738	5,319	1,706
Total imports of unwrought copper	do.	144,077	9,821	12,539	10,675	10,879	6,936	10,929
Re-exports of unwrought copper	do.	6,860	335	1,864	156	239	159	866
Exports of unwrought copper	do.	4,429	271	384	1,767	538	503	430
Total imports of wrought copper	do.	22,346	1,074	1,576	1,531	932	793	1,115
Exports of wrought copper	do.	20,848	1,954	1,867	2,104	1,558	1,332	1,351
Northern Rhodesia:								
Smelter output	Long ton	(b)66	—	—	—	—	—	—
Southern Rhodesia:								
Smelter output	Long ton	1,686	—	—	—	(c)8	—	—
South-West Africa Territory:								
Exports of copper ore	Long ton	53,401	—	5,266	7,824			
Union of South Africa:								
Copper content of marketable products:								
Transvaal	Long ton	5,482	638	525	696	531	495	400
Cape of Good Hope	do.	2,614	232	199	197	237	238	256
Canada:								
Copper content of ore produced in the Dominion	Long ton	49,755						
Copper content of matte exported from Ontario	do.	8,963	(a)843	(a)843	(a)843	(d)738	(d)738	(d)738
Smelter output in the Dominion	do.	24,735	2,707	2,548	2,631	2,932	2,686	1,597
Exports from the Dominion:								
Copper content of ore, matte and regulus	do.	27,021	2,141	1,620	4,411	263	3,551	2,433
Blister copper	do.	21,678	1,612	2,187	2,788	1,544	1,251	416
Unwrought copper and scrap	do.	2,502	71	160	360	168	189	218

(a) *Monthly average of first quarter*, 1926. (b) *Including an adjustment for the period* 1920-24 *inclusive*. (c) *Including an adjustment.* (d) *Monthly average of second quarter*, 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
COPPER (*contd.*)								
Canada (*contd.*)								
Imports into the Dominion :								
Unwrought copper and scrap	Long ton	5,403	449	427	2,136	218	471	703
Wrought copper . .	do.	13,704	860	983	721	670	603	931
India :								
Production of matte in Burma	Long ton	8,029	(*a*)857	(*a*)857	(*a*)857	(*b*)887	(*b*)887	(*b*)887
Australia :								
Queensland :								
Copper content of ore produced	Long ton	3,909	(*a*)30	(*a*)30	(*a*)30	(*b*)76	(*b*)76	(*b*)76
Tasmania :								
Copper content of ore produced	Long ton	6,539	(*a*)596	(*a*)596	(*a*)596	(*b*)504	(*b*)504	(*b*)504
Commonwealth :								
Output of blister copper .	Long ton	10,984	518	870	1,071	—	626	1,312
Value of matte and ingots exported . . .	£	242,366	1,488	1,576	34,188	42,300	29,245	8,265
FOREIGN COUNTRIES								
Austria :								
Production of ore . . .	Long ton	79,332	6,488	7,848	7,850	6,154	7,338	8,716
Belgium-Luxemburg E.U. :								
Imports of ore	Long ton	45,382	8,384	4,708	377	8,459	6,987	28,359
Imports of unwrought copper	do.	22,710	718	1,697	1,607	1,316	3,008	6,362
Exports of unwrought copper	do.	12,244	735	886	1,262	1,085	1,189	1,745
Imports of wrought copper .	do.	5,666	429	400	669	428	548	558
Exports of wrought copper .	do.	4,777	398	475	388	268	188	222
Czechoslovakia :								
Exports of ore	Long ton	212	83	183	486	131	78	17
Imports of unwrought copper and scrap	do.	16,111	668	1,015	979	1,780	1,125	1,021
Exports of unwrought copper and scrap	do.	2,668	182	152	484	212	103	317

France:								
Production of ore . . .	Long ton	2,735	849	1,175	1,992	2,027	1,154	
Germany:								
Imports of ore, matte and calcined cupreous pyrites .	Long ton	84,863	9,973	13,282	6,246	10,855	12,504	9,740
Exports of ore, matte and calcined cupreous pyrites .	do.	20,773	499	1,879	3,512	1,977	4,653	5,218
Imports of unwrought copper	do.	207,567	8,444	7,626	10,887	10,818	9,600	13,275
Exports of unwrought copper	do.	17,635	3,298	2,677	2,206	1,897	1,567	2,150
Imports of wrought copper .	do.	447	39	30	16	30	47	43
Exports of wrought copper .	do.	29,018	2,504	3,103	3,532	4,104	2,953	2,997
Italy:								
Production of ore . . .	Long ton	9,957						
Smelter production . .	do.	1,059						
Netherlands:								
Total imports of unwrought and wrought copper and scrap .	Long ton	9,010	748	939	594	794	840	724
Re-exports of unwrought and wrought copper and scrap .	do.	5,928	129	207	331	241	163	451
Spain:								
Copper content of ore produced	Long ton	30,000						
Algeria:								
Production of ore . . .	Long ton	1,722	49	167	202	182		
Belgian Congo:								
Smelter output . . .	Long ton	88,656	6,106	6,094	6,348	6,436	6,884	6,642
Cuba:								
Copper content of ore produced	Long ton	10,592						
Mexico:								
Copper content of ore produced	Long ton	50,511	1,351	4,467	4,563	5,535	4,606	5,369
Smelter output . . .	do.	32,365	3,039	2,811	3,374	3,373	3,113	3,359
United States:								
Copper content of total imports of ore, concentrates, matte and regulus . . .	Long ton	72,915	6,231	3,956	6,720	3,051	7,486	3,382

(a) *Monthly average of first quarter*, 1926. (b) *Monthly average of second quarter*, 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
COPPER (*contd.*)								
United States (*contd.*):								
Primary copper obtained from U.S. mines	Long ton	751,900	63,416	60,831	67,614	65,584	65,663	63,064
Smelter output	do.	845,833	70,157	67,527	72,071	76,742	75,893	68,898
Total imports of unrefined copper	do.	169,345	16,229	23,160	13,400	23,087	14,338	17,670
Total imports of refined copper	do.	44,542	6,155	3,246	3,624	4,573	5,650	6,392
Exports of refined copper	do.	432,172	27,865	24,407	32,225	37,466	29,770	34,544
Total imports of scrap	do.	4,655	238	221	1,328	841	291	447
Exports of scrap	do.	5,404	210	316	706	406	960	902
Exports of wrought copper	do.	11,899	1,968	2,516	2,108	2,240	1,648	2,430
Bolivia:								
Exports of ore	Long ton	14,423	1,022		1,127	1,201	1,467	2,069
Copper content of ore exported	*do.*		576		548	525	647	954
Chile:								
Exports of ore	Long ton	77,921	2,844	8,109	8,961	702	3,359	—
Production of copper bar	do.	173,166	16,032	16,518	16,139	14,299	15,209	13,893
Exports of copper bar	do.	153,820	13,558	15,317	18,341	16,125	15,794	11,037
Peru:								
Smelter output	Long ton	38,400	4,101	3,066	3,790	3,427	3,287	3,001
Exports of ore (*a*)	do.	922	424	33	847	117	797	65
Exports of matte (*a*)	do.	951	51	86	—	—	46	—
Exports of concentrates (*a*)	do.	554	35	45	132	—	56	38
Exports of bars	do.	36,208	2,734	1,816	5,284	3,176	5,285	1,251
Japan:								
Smelter output	Long ton	64,656	5,639	5,015	5,007	5,644	5,795	5,433
DIAMONDS								
BRITISH EMPIRE								
Gold Coast:								
Exports	Metric carat	77,314	20,995	22,663	40,803	1,106	18,135	
Southern Rhodesia:								
Production	Metric carat	189	3	—	—	—	—	—
Exports	do.	292	—	—	—			

South-West Africa Territory :								
Exports	Metric carat	515,090	42,510	42,471	49,103			
Union of South Africa :								
Production	Metric carat	2,430,128	221,898	201,593	230,448	208,231	226,057	236,821
Exports	do.	2,591,239	227,880	206,325	213,575			
Canada :								
Imports of unset diamonds .	£	587,693	56,892	82,890	83,843	15,401	75,002	73,703
Imports of diamond dust or bort and black diamonds for borers	£	107,869	11,310	24,266	5,944	25,915	26,059	8,446
British Guiana :								
Exports	Metric carat	198,297	13,586	7,030	5,411	15,490	4,426	12,300
Ceylon :								
Imports	Metric carat	1,052	5	—	—	£49	£129	1,591
India :								
Total imports from overseas .	£	536,285	30,399	47,644	62,084	22,227	38,053	49,033
FOREIGN COUNTRIES								
United States :								
Total imports of unset diamonds for glaziers, engravers and miners	Metric carat	46,556	4,810	2,697	4,619	2,854	2,783	1,561
Total imports of uncut diamonds	do	171,842	15,264	20,092	24,358	16,297	11,382	15,839
Total imports of cut diamonds, unset	do.	513,783	61,969	72,384	47,866	32,490	40,947	37,903
Total imports of diamond dust	£	157,481	8,802	7,736	6,244	6,890	7,942	6,942
GOLD								
PRODUCTION IN BRITISH EMPIRE								
Anglo-Egyptian Sudan (exports of bullion)	Troy oz.	8,745	826	756	720	561	549	642
Gold Coast	Fine troy oz.	190,930	15,800	14,420	14,852	13,848	14,418	13,990
Northern Rhodesia . . .	Fine troy oz.	1,250	172	—	60	1	91	—

(a) Copper is also contained in mixed ores, etc., exported.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	Apri 1926.	May 1926.	June 1926.
GOLD (*contd.*)								
Southern Rhodesia	Fine troy oz.	581,504	48,967	46,026	46,902	51,928	49,392	52,381
Swaziland	Troy oz.	1,309						
Union of South Africa:								
Total production	Fine troy oz.	9,597,592	799,509	753,960	834,286	803,265	846,761	847,537
By districts:								
Witwatersrand	do.	9,341,048	777,456	731,693	808,819	778,939	821,697	822,436
Other Transvaal	do.	256,525	22,053	22,267	25,467	24,326	25,064	25,101
Natal	do.	19	—	—	—	—	—	—
Canada (Ontario):								
Total crude bullion produced(*a*)	Troy oz.	(*b*) 1,465,774	121,998	120,351	138,725	134,867	123,695	122,780
By districts:								
Porcupine	do.	1,204,040	94,174	95,834	113,877	104,979	92,867	95,412
Kirkland Lake	do.	261,473	27,824	24,517	24,848	29,859	30,739	27,339
Miscellaneous	do.	261	—	—	—	29	89	29
British Guiana (exports)	Troy oz.	6,974	42	979	—	722	—	1,248
Federated Malay States:								
Pahang (exports)	Troy oz.	12,496	—	879	793	904	831	1,740
Perak	do.	1,659	31	66	121	137	164	164
India	Fine troy oz.	392,900	31,687	30,050	31,809	31,453	32,188	31,797
Australia:								
New South Wales	Fine troy oz.	19,422	1,497	1,226	1,154	2,562	536	939
Victoria	do.	47,296	1,914	3,685	4,599	3,870	4,297	4,943
Queensland	do.	44,332	604	488	466	663	1,393	906
Western Australia	do.	441,252	29,302	34,685	30,628	43,695	35,438	39,682
Tasmania	do.	3,524	(*c*) 356	(*c*) 356	(*c*) 356	(*e*) 219	(*e*) 219	(*e*) 219
Commonwealth	do.	556,000						
New Zealand (exports)	Troy oz.	114,669	5,015	8,582	13,906	10,492	8,800	13,712
PRODUCTION IN FOREIGN COUNTRIES								
France (gold ores)	Long ton	56,709	5,199	5,313	6,110	5,559	5,746	
Italy	Troy oz.	2,205						

Russia	Fine troy oz.	734,400						
Belgian Congo (Kilo Moto only)	Troy oz.	115,901	(*d*)9,574	(*d*)9,574	(*d*)9,574	(*d*)9,574	(*d*)9,574	(*d*)9,574
Madagascar (exports)	Troy oz.	6,336	836	995	1,840			
Mexico	Fine troy oz.	788,993	54,430	70,376	73,624	68,254	59,767	70,023
United States	Fine troy oz.	2,319,920						
Bolivia :								
Quantity of gold exported	Troy oz.	386	—		64	—	—	—
Value of gold exported	£	1,274	—		114	—	—	—
Brazil	Fine troy oz.	120,330						
Ecuador	Fine troy oz.	43,000						
Japan	Fine troy oz.	280,000						
Philippine Islands (exports of bullion)	Troy oz.	159,580	13,194	14,299	12,141	15,963	12,641	10,659
GYPSUM								
BRITISH EMPIRE								
Canada :								
Production of gypsum	Long ton	661,003						
Exports of crude gypsum	do.	476,469	39,375	2,054	2,455	—	—	86,161
Imports of crude gypsum	do.	3,958	104	131	83	75	3	91
Imports of ground gypsum	do.	105	29	21	11	6	29	(1 *cwt.*)
Exports of plaster of Paris, etc.	do.	5,038	99	714	3,972	418	627	362
Imports of plaster of Paris, etc.	do.	3,902	120	123	280	218	339	298
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Exports of crude gypsum	Long ton	2,892	290	51	342	1,264	1,493	1,240
Imports of crude gypsum	do.	85,644	8,578	9,426	10,416	13,039	11,234	8,873
Exports of ground gypsum	do.	7,623	360	242	852	357	499	459
Imports of ground gypsum	do.	32,774	2,274	3,816	4,227	2,603	3,174	3,689
Czechoslovakia :								
Imports of crude gypsum	Long ton	18,040	288	1,022	1,599	1,292	1,968	1,789
Imports of calcined gypsum	do.	32,148	1,475	2,263	3,067	3,324	3,424	3,356

(*a*) *Including a small quantity of silver.* (*b*) *Gold content of ore produced in the Dominion during* 1925 *was* 1,735,735 *fine troy ounces.*
(*c*) *Monthly average of first quarter,* 1926. (*d*) *Monthly average of first half-year,* 1926. (*e*) *Monthly average of second quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
GYPSUM (*contd.*)								
France:								
Exports of plaster of Paris	Long ton	206,425	14,676	20,895	16,790	21,800	19,095	24,858
Imports of plaster of Paris	do.	13,912	487	488	996	897	2,085	1,720
Germany:								
Exports of gypsum and gypsum-superphosphate	Long ton	109,021	5,551	6,099	7,747	9,683	9,624	9,549
Imports of gypsum and gypsum-superphosphate	do.	7,473	84	331	489	638	660	741
Italy:								
Exports of gypsum	Long ton	1,186	15	452	123	39	118	207
Imports of gypsum	do.	3,078	159	326	209	141	274	268
Production of gypsum and alabaster	do.	662,707						
Exports of crude alabaster	do.	2,922	91	147	116	152	101	137
Netherlands:								
Imports of gypsum	Long ton	18,782	1,211	1,422	1,815	2,042	2,322	1,603
United States:								
Total imports of crude gypsum	Long ton	566,449	19,566	1	5,865	25,856	72,244	104,813
IRON ORE								
BRITISH EMPIRE								
United Kingdom:								
Total production in Great Britain	Long ton	10,142,855	(*b*)861,069	(*b*)861,069	(*b*)861,069			
By kinds:								
West coast haematite (non-phosphoric)	do.	951,873	(*b*)96,854	(*b*)96,854	(*b*)96,854			
Jurassic ironstones:								
Lower Lias	do.	1,988,268	(*b*)180,243	(*b*)180,243	(*b*)180,243			
Middle Lias: Cleveland	do.	2,284,186	(*b*)179,380	(*b*)179,380	(*b*)179,380			
Other	do.	1,527,400	(*b*)128,554	(*b*)128,554	(*b*)128,554			
Inferior Oolite	do.	2,948,413	(*b*)241,338	(*b*)241,338	(*b*)241,338			
Coal measure ironstones	do.	342,998	(*b*)26,655	(*b*)26,655	(*b*)26,655			
Other haematite, brown ore, etc.	do.	99,717	(*b*)8,045	(*b*)8,045	(*b*)8,045			

Total imports	do.	4,381,907	386,781	421,544	464,823	418,882	191,501	68,250
Exports	do.	2,582	88	196	359	111	1,313	1,209
Southern Rhodesia :								
Production	Long ton	1,046	223	437	—	234	235	763
Union of South Africa :								
Production	Long ton	—	—	612	1,051	1,282	1,518	2,471
Canada :								
Imports	Long ton	926,094	18,251	274	976	1,920	35,631	167,026
Exports	do.	3,932	58	36	—	40	—	36
British Malaya :								
Exports	Long ton	271,995	16,376	17,412	23,117	8,802	33,426	19,545
Australia (Queensland) :								
Production	Long ton	(*a*)303	(*b*)544	(*b*)544	(*b*)544	(*c*)503	(*c*)503	(*c*)503
FOREIGN COUNTRIES								
Austria :								
Production in Styria and Carinthia	Long ton	1,008,561	96,752	115,597	108,969	96,054	97,027	91,343
Belgium-Luxemburg E.U. :								
Imports	Long ton	8,744,363	652,354	812,739	1,020,883	988,014	683,730	894,148
Exports	do.	1,763,644	152,172	129,346	142,587	113,007	75,811	79,175
Czechoslovakia :								
Imports	Long ton	812,950	19,769	13,844	45,017	19,761	56,037	96,332
Exports	do.	81,030	12,714	11,257	13,526	11,112	15,947	14,410
France :								
Total extracted	Long ton	35,166,783	3,088,084	2,964,808	3,277,734	2,932,034	2,975,757	
Of which, merchantable ore :								
Non-phosphoric	do.	241,805	18,435	18,407	20,366	19,850	21,373	
Slightly phosphoric	do.	1,482,746	125,977	126,696	146,448	141,556	134,535	
Phosphoric	do.	33,158,521	2,916,096	2,801,481	3,084,750	2,759,696	2,805,260	
Exports	do.	9,078,408	600,499	843,659	944,689	864,460	939,610	895,126
Imports	do.	1,218,141	31,154	162,939	98,248	87,691	75,554	187,924

(*a*) *Iron ore produced in the Commonwealth during* 1925 *was* 738,686 *long tons.* (*b*) *Monthly average of first quarter,* 1926. (*c*) *Monthly average of second quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
IRON ORE (*contd.*)								
Germany:								
Imports	Long ton	11,354,546	510,486	661,313	587,950	703,268	709,038	726,539
Exports	do.	198,500	13,953	22,876	15,511	9,045	13,124	11,087
Hungary:								
Production	Long ton	66,968	11,290	11,025	10,955	9,792	11,126	10,315
Italy:								
Production	Long ton	505,001						
Imports	do.	304,314	25,095	21,964	27,008	32,209	28,410	24,524
Luxemburg:								
Production	Long ton	6,564,862						
Norway:								
Exports	Long ton	417,836	14,734	8,116	12,078	14,754	2,322	—
Poland:								
Production	Long ton						21,907	26,527
Russia:								
Production	Long ton	(d)2,160,904	234,952	254,573	266,254	264,505		
Sweden:								
Exports	Long ton	8,658,932	411,857	437,142	537,924	511,222	538,969	675,967
Switzerland:								
Exports	Long ton	58,573	2,128	1,684	1,589	1,807	3,184	5,467
Imports	do.	41,751	740	152	1,848	2,691	5,632	8,380
Algeria:								
Total extracted	Long ton	1,772,228	159,505	167,169	166,923			
Of which, merchantable ore:								
Non-phosphoric	do.	1,731,690	157,251	160,004	163,785			
Slightly phosphoric	do.	25,666	3,267	4,255	4,804			
Tunis:								
Production (all non-phosphoric)	Long ton	711,000	58,000	53,000	60,000			
Cuba:								
Production	Long ton	900,000						
United States:								
Production	Long ton	(e)63,328,517						
Shipments from mines through Upper Lake Ports	do.	54,075,000	—	—	—	10,000	6,113,000	8,770,000

Total imports	do.	2,190,697	202,332	160,172	184,122	194,731	238,678	272,449
Exports	do.	630,700	888	819	858	2,022	77,384	105,387
Chile:								
Exports	Long ton	1,214,260	121,472	87,938	—	245,283	99,437	118,349
LEAD								
BRITISH EMPIRE								
United Kingdom:								
Lead content of ore produced in Great Britain	Long ton	12,463	(e)1,333	(e)1,333	(e)1,333			
Smelter output	do.	4,735	(b)326	(b)326	(b)326	(b)326	(b)326	(b)326
Total imports of pig-lead and sheets	do.	275,072	26,898	22,632	19,148	30,652	18,752	18,741
Re-exports of pig-lead and sheets	do.	14,573	990	292	648	844	49	1,201
Exports of pig-lead	do.	6,380	66[illegible]	363	331	401	270	421
Exports of wrought lead	do.	6,611	624	614	823	625	686	437
Northern Rhodesia:								
Smelter output	Long ton	2,993	80	—	—	—	—	246
Exports of pig-lead	do.	3,645	100	—	—			
Southern Rhodesia:								
Lead content of ore produced	Long ton	4	—	—	—	—	—	—
South-West Africa Territory:								
Exports of pig-lead	Long ton	1,525	—	—	—			
Union of South Africa:								
Lead content of sales and shipments of ore:								
Transvaal	Long ton	1,602	3	8	6	3	10	6
Cape of Good Hope	do.	127	14	7	21	7	14	9
Canada:								
Lead content of ore produced	Long ton	113,210						
Lead content of ore exported	do.	16,743	1	—	(c)	—		
Smelter output	do.	110,962	10,661	9,709	9,659	9,395	11,354	11,020
Exports of pig-lead	do.	71,487	5,883	6,981	13,375	5,108	7,982	6,697

(a) *Excluding ore containing 5 per cent. or more of manganese.* (b) *Monthly average of first half-year,* 1926. (c) *Less than ½ ton.*
(d) *Year ended 30th September,* 1925. (e) *Monthly average of first quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
LEAD (*contd.*)								
India :								
Lead content of ore produced in Burma	Long ton	66,500	(*a*)6,778	(*a*)6,778	(*a*)6,778	(*c*)6,009	(*c*)6,009	(*c*)6,009
Refinery output in Burma .	do.	47,665	4,700	4,725	4,700	(*c*)4,739	(*c*)4,739	(*c*)4,739
Exports of pig-lead overseas .	do.	41,137	5,150	1,421	8,086	3,452	3,620	3,872
Total imports of wrought lead from overseas . . .	do.	2,394	212	237	251	111	78	29
Australia :								
Lead content of ore produced in (*b*) :								
Queensland . . .	Long ton	4,836	(*a*)190	(*a*)190	(*a*)190	(*c*)386	(*c*)386	(*c*)386
Tasmania	do.	5,526	(*a*)414	(*a*)414	(*a*)414	(*c*)464	(*c*)464	(*c*)464
Exports of ore and concentrates overseas from :								
Victoria (ore) . . .	do.	86	—	—	—	—	—	—
Western Australia (concentrates)	do.	4,823	—	672	—	936	319	—
South Australia (concentrates)	do.	29,877	—	2,001	—	—	1,007	413
Exports of silver-lead ore and concentrates overseas from :								
New South Wales . .	do.	986	—	106	—	415	341	237
Western Australia . .	do.	87	—	—	—	69	—	—
Queensland . . .	do.	1,162	268	15	1,000	42	16	10
South Australia . .	do.	770	—	—	—	12	—	63
Tasmania	do.	7,117	—	834	101	931	—	805
Smelter output in Commonwealth	do.	148,880	11,481	10,104	9,646	10,858	13,043	13,769
Exports overseas of pig-lead from :								
New South Wales . .	do.	73,796	5,464	3,969	10,027	5,264	6,307	4,718
Queensland (silver-lead bullion)	do.	3,037	—	—	—	547	570	500
South Australia . .	do.	43,652	7,259	10,005	998	891	998	8,591

Value of matte and pig-lead exported from Commonwealth	£	4,718,275	457,670	509,107	392,853	173,103	194,419	408,642
FOREIGN COUNTRIES								
Austria :								
Carinthia :								
Production of lead ore .	Long ton	5,527	356	2	351	779	598	691
Production of wulfenite .	Cwt.	382	—	—	(*d*)	—	61	93
Smelter output . .	Long ton	5,322	418	373	522	596	825	396
Tyrol : Production of lead ore	do.	7,424	522	494	555	678	670	674
Belgium-Luxemburg E.U. :								
Imports of ore . . .	Long ton	34,030	5,159	6,128	17,733	3,806	4,059	14,314
Exports of ore . . .	do.	396	78	55	130	6	14	27
Imports of pig-lead and scrap	do.	11,140	1,243	449	940	1,192	1,406	2,534
Exports of pig-lead and scrap	do.	14,376	1,624	1,909	2,426	2,426	1,957	2,025
Imports of wrought lead, etc.	do.	1,103	22	34	22	30	18	13
Exports of wrought lead, etc.	do.	9,681	560	726	967	924	661	1,235
Czechoslovakia :								
Imports of pig-lead and scrap	Long ton	5,994	405	425	690	645	438	496
France :								
Production of lead ore . .	Long ton	16,417	2,389	1,750	843	974	886	
Production of lead-zinc ore .	do.				1,807	1,328	1,558	
Imports of ore . . .	do.	30,400	6,549	405	1,868	2,918	2,014	3,503
Exports of ore . . .	do.	8,623	392	725	539	474	172	674
Imports of pig-lead and scrap .	do.	70,325	3,688	5,783	7,248	7,969	4,341	8,626
Exports of pig-lead and scrap .	do.	2,849	87	74	121	55	174	88
Germany :								
Imports of ore . . .	Long ton	34,705	3,006	5,176	4,393	3,020	4,730	4,171
Exports of ore . . .	do.	7,174	397	1,012	681	486	792	1,496
Smelter output . . .	do.	46,000						
Imports of pig-lead and scrap .	do.	135,531	7,398	5,135	4,371	4,998	6,956	7,209
Exports of pig-lead and scrap.	do.	15,087	1,199	1,586	2,096	1,226	1,194	1,516
Exports of wrought lead .	do.	3,545	373	376	482	74	626	842

(*a*) *Monthly average of first quarter*, 1926. (*b*) *Lead content of ore produced in the Commonwealth during* 1925 *was* 184,606 *long tons.* (*c*) *Monthly average of second quarter*, 1926. (*d*) *Less than* ½ *ton.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
LEAD (*contd.*)								
Italy :								
Lead content of ore produced	Long ton	28,225						
Imports of ore, including argentiferous	do.	6,980	514	720	4	1,201	33	703
Exports of ore, including argentiferous	do.	12,519	3,310	686	143	9	2,682	371
Smelter output . . .	do.	24,081	2,330	2,146	1,543	827	2,071	2,317
Imports of pig-lead and scrap (*a*)	Long ton	26,183	947	2,907	1,989	1,699	1,703	1,208
Exports of pig-lead and scrap (*a*)	do.	8,532	14	16	—	3	3	12
Netherlands :								
Imports of pig-lead and scrap .	Long ton	11,875	1,413	1,219	1,479	939	1,722	1,806
Imports of wrought lead .	do.	3,657	300	112	150	210	232	342
Russia :								
Production of lead-zinc ore .	Long ton		2,526	2,790	2,798	2,770		
Production of lead concentrates	do.		88	89	116	187		
Spain and Tunis (*b*) **:**								
Smelter output . . .	Long ton	114,680	9,466	8,913	10,369	10,030	8,633	9,685
Upper Silesia :								
Production of ore . . .	Long ton	19,013						
Smelter production . .	do.	20,980				2,259	2,204	2,400
Algeria :								
Production of ore . . .	Long ton	15,369	1,348	1,692	1,490	1,211		
Tunis :								
Production of ore (see Spain)	Long ton	36,494	2,972	3,021	3,483	2,971		
Mexico :								
Lead content of ore produced	Long ton	169,007	6,223	24,987	19,198	13,997	16,052	14,483
Smelter output (*c*) . .	do.	181,500	14,644	13,269	17,217	20,843	17,354	17,437
United States :								
Lead content of ore produced .	Long ton	609,068	52,048	50,050	50,321	47,291	49,509	43,709
Smelter output (*d*) . .	do.	654,888	45,354	42,504	46,724	41,712	44,567	42,432
Lead content of total imports of:								
Ore and matte . . .	do.	39,715	3,535	4,508	5,051	3,029	3,510	1,700

Bullion and base bullion .	do.	63,059	3,820	4,047	1,977	7,059	7,609	5,568
Pig-lead and bars . .	do.	5,713	700	164	392	503	250	400
Scrap and alloys . .	do.	556	50	4	7	51	83	128
Type metal and antimonial lead	do.	1,924	64	66	937	383	9	149
Exports of pig-lead, bars, etc., produced from :								
Domestic ore . . .	do.	4,425	25	54	1,188	1,659	31	94
Foreign ore . . .	do.	87,428	5,444	2,253	2,115	4,219	4,129	7,295
Argentina :								
Smelter output . . .	Long ton	7,700						
Bolivia :								
Exports of ore, etc. . .	Long ton	36,246	2,778		2,837	2,518	2,006	1,645
Lead content of ore, etc., exported	*do*		*1,662*		*1,617*	*1,536*	*1,134*	*983*
MANGANESE ORE								
BRITISH EMPIRE								
United Kingdom :								
Total imports . . .	Long ton	278,647	15,555	23,179	19,310	23,124	13,016	24,120
Re-exports	do.	1,370	1,250	50	43	5	—	—
Gold Coast :								
Exports	Long ton	338,657						
Union of South Africa (Transvaal) :								
Sales and shipments . .	Long ton	448	—	—	—	101	71	36
Canada :								
Exports	Long ton	434	—	—	—	—	—	62

(*a*) *Including antimonial lead*

(*b*) *Incomplete figures.*

(*c*) *Including lead produced in the United States from Mexican ore, which averaged 2,500 long tons per month during 1924.*

(*d*) *Monthly figures exclude lead produced from Mexican ore.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
MANGANESE ORE (*contd.*)								
India :								
Exports overseas . . .	Long ton	604,198	45,155	33,671	41,681	48,328	38,720	42,880
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports	Long ton	196,895	18,280	16,560	16,972	16,817	29,753	23,910
Czechoslovakia :								
Imports	Long ton	668	581	529	698	205	—	54
France :								
Production	Long ton	3,134	247	260	248	148	—	
Imports	do.	462,015	53,316	42,870	35,506	35,274	67,832	38,111
Exports	do.	1,696	180	255	184	43	74	159
Germany :								
Imports	Long ton	196,171	16,135	8,537	5,659	14,958	18,019	11,308
Exports	do.	360	—	98	44	129	2	—
Italy :								
Production	Long ton	14,743						
Imports	do.	67,659	4,509	285	295	584	3,102	14,354
Exports	do.	2,553	70	158	39	172	173	217
Russia (*b*) **:**								
Production of crude ore (*a*) .	Long ton		105,686	60,646	59,254	72,430		
Production of washed ore (*a*) .	do.		49,829	34,627	33,953	41,789		
Exports	do.		70,708	36,608	78,518			
Tunis :								
Production	Long ton	1,702	100	256	153	103		
United States :								
Imports of ore	Long ton	12,475	4,500	174	237	90	29	13
Manganese content of other imports of ore (*c*) .	do.	278,917	37,498	27,239	27,391	55,047	21,633	31,315
Brazil :								
Exports	Long ton	306,870	25,361	38,010	31,786	47,214	23,358	

MICA								
BRITISH EMPIRE								
United Kingdom:								
Total imports	Long ton	2,693	116	104	159	240	166	213
Re-exports	do.	1,383	62	67	66	73	32	116
Southern Rhodesia:								
Production	Long ton	130	4	4	21	15	5	21
Exports	do.	195	11	2	5			
Union of South Africa:								
Production	Long ton	1,439	18	73	63	101	100	83
Exports	do.	839	—	—	—			
Canada (*d*):								
Exports of:								
Scrap and waste . .	Long ton	4,457	92	200	206	64	250	513
Rough cobbed and thumb-trimmed mica . .	do.	25	—	(*e*)	(*e*)	2	2	4
Splittings	do.	206	41	40	20	45	23	11
India:								
Exports of blocks overseas .	Long ton	748	22	148	57	43	49	112
Exports of splittings overseas	do.	4,237	340	348	423	356	343	573
FOREIGN COUNTRIES								
Germany:								
Imports.	Long ton	1,223	94	72	70	53	47	158
France:								
Imports	Long ton	736	56	71	85	47	75	36
Exports	do.	402	21	37	36	11	13	43
Madagascar:								
Exports of muscovite . .	Long ton	36	2	(*e*)	2			
Exports of phlogopite, etc. .	do.	226	11	25	24			
United States:								
Exports	Long ton	1,081	72	73	45	133	87	33
Imports	do.	280	23	32	16	31	16	43

(*a*) *Excluding Tchiaturi.* (*b*) *Production of manganese ore in Russia during the year ended 30th September, 1925, was 512,721 long tons.* (*c*) *Additional to previous item.* (*d*) *Production of mica during 1925 was 3,153 long tons.* (*e*) *Less than ½ ton.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
NICKEL								
BRITISH EMPIRE								
Canada :								
Production in Ontario :								
Nickel in matte exported	Long ton	14,637	(a) 1,300	(a) 1,300	(a) 1,300	(b) 1,018	(b) 1,018	(b) 1,018
Nickel	do.	14,275	(a) 1,374	(a) 1,374	(a) 1,374	(b) 885	(b) 885	(b) 885
Nickel oxide	do.	4,059	(a) 238	(a) 238	(a) 238	(b) 492	(b) 492	(b) 492
Exports :								
Nickel content of ore, matte or speiss	do.	17,950	978	621	3,252	362	2,015	1,394
Nickel	do	13,445	1,093	757	789	1,008	548	823
Imports of nickel and nickel-silver	do.	473	81	22	45	22	54	51
India :								
Total imports of nickel and alloys from overseas	Long ton	969	125	59	87	69	72	99
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports of wrought nickel	Long ton	442	19	13	13	11	29	18
Exports of wrought nickel	do.	1,446	311	92	170	153	152	113
Imports of unwrought nickel and scrap	do.	2,617	212	183	9	330	53	350
Exports of unwrought nickel and scrap	do.	584	110	122	50	60	44	16
France :								
Imports of ore, matte and speiss	Long ton	1,548	301	—	263	—	23	308
Imports of nickel and nickel-silver	do.	901	141	122	115	158	197	116
Exports of nickel and nickel-silver	do.	514	21	39	31	44	8	10

Germany :								
Imports of ore	Long ton	2,753	182	65	30	32	205	52
Imports of unwrought nickel, scrap and coin	do.	2,481	22	76	124	250	140	86
Exports of unwrought nickel, scrap and coin	do.	659	102	61	34	28	57	69
Netherlands :								
Imports of unwrought and wrought nickel, etc.	Long ton	508	63	44	24	56	44	63
United States :								
Total imports of ore and matte	Long ton	4,425	730	802	566	395	—	576
Total imports of nickel and nickel-silver	do.	14,302	1,468	722	692	1,394	1,897	794
Exports of nickel-silver	do.	220	102	117	111	111	39	40
New Caledonia :								
Exports of ore	Long ton	12						
Exports of matte	do.	4,364						
PETROLEUM (INCLUDING SHALE-OIL)								
BRITISH EMPIRE								
Trinidad :								
Production	Long ton	626,644	59,362	51,264	55,564	56,790	63,779	
Exports :								
Crude petroleum	Gallon	10,513,048	2,225,566	1,040	2,114,673	920	1,080	1,532
Gasoline	do.	13,425,650	326,412	376,476	2,308,699	1,199,995	2,096,135	2,066,935
Kerosene	do.	2,735,831	94,658	15,987	95,600	76,243	60,596	43,754
Fuel-oil	do.	99,525,178	2,746,528	8,204,757	18,311,530	3,578,768	7,790,839	11,118,901
Lubricating oil	do.	28,064	—	40	176	308	258	512
India :								
Production	Long ton	1,193,779						
Exports overseas :								
Benzine and other light oils	Gallon	12,822,072	—	392	2,595	—	—	2,218,496
Other mineral oils	do.	137,242	6,628	10,989	11,455	4,693	8,955	5,516

(*a*) *Monthly average of first quarter*, 1926. (*b*) *Monthly average of second quarter*, 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
PETROLEUM (INCLUDING SHALE-OIL) (*contd.*)								
Sarawak :								
Production	Long ton	603,270						
FOREIGN COUNTRIES								
France :								
Production	Long ton	67,753	5,790	5,105	6,755	6,356	5,500	
Germany :								
Production	Long ton	77,833						
Italy :								
Production	Long ton	5,067						
Poland :								
Production	Long ton	798,862	67,715	60,703	68,811	67,121	68,190	66,000
Rumania :								
Total production . . .	Long ton	2,274,535	221,665	221,329	244,344	239,520	279,265	286,000
By fields :								
Prahova	do.	1,821,962	164,842	170,113	187,749	174,413	202,057	
Dambovitza . . .	do.	291,808	42,817	38,085	41,959	50,737	62,540	
Other fields . . .	do.	160,765	14,006	13,131	14,636	14,370	14,668	
Russia :								
Total production . . .	Long ton	7,500,000	625,000	573,000	633,000	655,000		
Of which, Baku . . .	do.	4,900,000	424,028	399,265	432,011	441,000		
Algeria :								
Production	Long ton	1,791		151	171	109		
Egypt :								
Production	Long ton	175,069	12,537	11,971	15,202	12,159	12,556	16,727
Mexico :								
Production (*a*) . . .	Long ton	16,502,100	1,359,838	1,220,914	1,190,793	1,245,167		
United States (*a*) (*b*) :								
Total production . . .	Long ton	107,978,900	8,524,300	7,794,900	8,667,000	8,56[illegible],700	8,936,600	8,820,300
By fields :								
Appalachian . . .	do.	3,895,800	309,700	302,600	341,600	339,900	337,000	349,900
Lima-Indiana . . .	do.	303,000	22,400	22,600	25,600	24,400	25,400	27,900

Michigan	do.	—	—	—	—	—	600	400
Illinois-S.W. Indiana	do.	1,214,700	98,400	93,600	111,300	90,400	101,000	102,600
Mid-Continent	do.	60,138,000	4,542,700	4,137,100	4,637,100	4,696,300	4,952,500	4,901,400
Gulf Coast	do.	4,494,000	390,600	370,300	380,400	380,700	386,700	362,300
Rocky Mountain	do.	5,055,100	436,200	416,700	481,600	453,400	466,700	466,000
California	do.	32,878,300	2,724,300	2,452,000	2,689,400	2,584,600	2,666,700	2,609,800
By class:								
Light crude, 24° (0·910) and lighter	do.	77,169,700	6,160,700	5,651,500	6,288,000	7,016,600	7,346,000	7,295,000
Heavy crude, heavier than 24° A.P.I.	do.	30,809,200	2,363,600	2,143,400	2,379,000	1,553,100	1,590,600	1,525,300
Argentina:								
Production	Long ton	930,515						
Colombia:								
Production	Long ton	70,000						
Peru:								
Production	Long ton	1,600,000						
Venezuela:								
Production	Long ton	2,950,856	385,894	353,528	403,014	421,919		421,400
Dutch East Indies:								
Production	Long ton	3,140,000						
Japan:								
Production	Long ton	237,000						
Persia:								
Production	Long ton	4,578,428						
PHOSPHATES								
BRITISH EMPIRE								
United Kingdom:								
Total imports of phosphate-rock and phosphate of lime	Long ton	338,403	41,512	22,105	26,970	11,687	23,774	18,310
Exports of superphosphates	do.	18,721	1,067	1,796	1,690	1,949	1,074	651

(*a*) *Converted at the rate of 7 barrels = 1 long ton.*
(*b*) *Figures refer to petroleum transported from the fields. The production, including fuel consumed and stocked, was* 109,106,100 *long tons during* 1925.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
PHOSPHATES (*contd.*)								
Canada :								
Imports of phosphate-rock .	Long ton	12,502	—	—	130	121	(*a*)	4,503
Imports of superphosphates .	do.	56,700	4,463	6,392	11,065	6,863	8,082	3,216
Ceylon :								
Imports of superphosphates .	Long ton	3,761	560	512	614	246	121	50
New Zealand :								
Total imports of phosphate-rock, superphosphates and fertilisers	Long ton	174,994	4,965	2,394	21,515	16,978	21,475	41,644
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports of phosphate-rock .	Long ton	321,126	18,396	33,359	38,052	29,801	26,384	38,353
Exports of phosphate-rock .	do.	65,403	11,297	5,913	7,092	5,448	6,712	6,456
Imports of superphosphates .	do.	26,662	2,766	6,747	10,814	3,449	882	117
Exports of superphosphates .	do.	173,408	25,779	33,322	57,930	30,130	9,987	5,483
Czechoslovakia :								
Imports of phosphate-rock .	Long ton	115,380	6,579	2,646	8,712	9,362	23,716	9,692
Imports of superphosphates .	do.	14,273	39	4,250	7,109	975	98	1,486
Exports of superphosphates .	do.	4,731	20	588	469	3,510	11	375
Denmark :								
Total imports of phosphate-rock	Long ton	124,794	17,845	9,724	11,072	12,625	8,957	7,324
Total imports of superphosphates	do.	144,975	34,208	43,106	22,772	5,223	135	2
France :								
Production of phosphate-rock	Long ton					449	166	
Imports of phosphate-rock .	do.	1,274,892	110,183	114,115	154,558	131,618	133,678	129,314
Imports of superphosphates .	do.	21,927	200	584	749	652	179	77
Exports of superphosphates .	do.	225,676	16,108	28,907	29,441	24,350	9,271	5,941

Germany:								
Imports of phosphate-rock .	Long ton	392,954	28,455	42,834	29,350	57,711	31,209	37,805
Imports of superphosphates .	do.	39,327	2,739	4,080	11,972	9,266	1,157	2,039
Exports of superphosphates .	do.	45,007	7,769	6,904	18,945	9,833	2,820	328
Italy:								
Imports of phosphate-rock .	Long ton	823 312	82,385	77,301	69,637	69,477	94,276	76,064
Netherlands:								
Imports of phosphate-rock .	Long ton	325,408	43,956	28,473	28,667	24,789	21,838	29,747
Imports of superphosphates	do.	93,131	12,685	39,110	37,751	16,921	3,032	764
Exports of superphosphates .	do.	377,257	41,464	37,579	50,793	8,767	31,026	11,338
Norway:								
Total imports of superphosphates	Long ton	21,665	1,330	5,219	9,853	7,029	1,242	10
Russia:								
Production of phosphate-rock	Long ton		4,824	6,511	5,901	3,852		
Sweden:								
Imports of phosphate-rock .	Long ton	144,074	4,558	14,016	19,268	3,444	5,121	14,758
Exports of superphosphates .	do.	87,185	4,356	4,639	3,980	3,187	2,528	1,133
Algeria:								
Production of phosphate-rock	Long ton	705,114	74,329	75,303	82,896	70,535		
Egypt:								
Exports of phosphate-rock .	Long ton	65,292	6,188	8,983	10,894	6,472	37,769	8,885
Total imports of superphosphates	do.	54,906	2,466	98	492	202	—	—
Morocco:								
Sales of phosphates . .	Long ton	709,100						
Tunis:								
Production of phosphate-rock	Long ton	2,648,000	219,000	214,000	235,000	195,000		
United States:								
Production of superphosphates	Long ton		391,262	300,116	309,091	266,274	202,917	
Exports of phosphate-rock .	do.	870,276	40,333	70,849	70,616	78,350	87,491	64,633
Exports of superphosphates .	do.	66,879	4,019	7,967	13,885	5,310	7,902	1,653

(a) *Less than ½ ton.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
PLATINUM, &c.								
BRITISH EMPIRE								
Union of South Africa (Transvaal):								
Production of crude platinum	Troy oz.		209	727	363	841	1,052	1,180
Sales and shipments of osmiridium	Troy oz.	6,055	628	150	275	390	393	253
Canada (Ontario):								
Production of platinum metals	Troy oz.	16,980	(*a*)138	(*a*)138	(*a*)138	(*b*)3,281	(*b*)3,281	(*b*)3,281
Canada:								
Platinum content of exports of concentrates, etc. . .	Troy oz.	404	70	60	89	44	—	50
Exports of scrap . . .	do.	655	55	41	—	51	—	23
Australia:								
Victoria: Export overseas of osmiridium	Troy oz.	2,004	—	214	128	150	132	151
Tasmania: Production of osmiridium	do.	3,366	(*a*)338	(*a*)338	(*a*)338	(*b*)242	(*b*)242	(*b*)242
FOREIGN COUNTRIES								
United States:								
Production from placers .	Troy oz.	343						
Imports of ore (platinum content)	do.		4	871	16	—	18	3
Exports of unwrought platinum	do.	16,234	2,487	1,392	1,112	510	574	1,145
Imports of unwrought platinum	do.	106,478	9,307	7,596	7,596	6,450	15,400	7,062
Imports of iridium, osmium, palladium, etc. . . .	do.	14,931	1,719	1,421	1,311	1,443	853	1,873
PYRITES								
BRITISH EMPIRE								
United Kingdom:								
Production in Great Britain, including arsenical pyrites .	Long ton	5,315	(*a*)515	(*a*)515	(*a*)515			

23

Total imports, including cupreous pyrites . . .	do.	275,322	25,173	23,944	33,475	24,069	18 102	6,460
Union of South Africa (Transvaal) :								
Sales and shipments . .	Long ton	2,472	168	155	216	177	181	258
Canada :								
Production	Long ton	13,933						
FOREIGN COUNTRIES								
Austria :								
Production in Styria . .	Long ton	10,843	507	476	667	728	885	828
Czechoslovakia :								
Imports of pyrites . .	Long ton	148,196	4,083	3,264	15,677	16,344	24,534	18,850
Imports of pyrites waste .	do.	105,268	8,516	8,251	10,187	10,642	9,537	8,670
Exports of pyrites and waste .	do.	1,206	466	251	625	531	335	1,899
France :								
Production	Long ton	194,736	14,589	15,204	15,164	15,802	13,608	
Imports	do.	477,362	40,126	25,328	61,810	63,558	33,674	83,141
Germany :								
Imports of pyrites and other sulphur minerals . .	Long ton	917,630	46,140	51,892	69,684	73,096	64,212	62,547
Exports of pyrites and other sulphur minerals . .	do.	11,471	528	342	316	951	451	723
Italy :								
Production of iron pyrites .	Long ton	485,870						
Production of cupreous pyrites	do.	39,289						
Imports of iron pyrites . .	do.	193,165	9,991	10,494	15,012	15,585	4,039	28,248
Exports of iron pyrites . .	do.	170,762	9,839	4,532	11,851	2,942	12,410	4,039
Exports of cupreous pyrites .	do.	4,271	—	—	—	—	—	—
Netherlands :								
Imports of iron pyrites . .	Long ton	98,842	5,766	15,288	12,583	3,323	12,085	22,414
Norway :								
Exports of iron pyrites . .	Long ton	94,135	1,503	4,523	17,373	16,496	7,681	4,709
Exports of cupreous pyrites .	do.	435,878	34,134	28,488	50,214	31,230	28,183	24,058

(*a*) *Monthly average of first quarter,* 1926. (*b*) *Monthly average of second quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
PYRITES (*contd.*)								
Russia :								
Production of iron pyrites .	Long ton		5,562	7,126	4,928	3,335		
Production of cupreous pyrites	do.		25,207	30,285	33,669	33,922		
Algeria :								
Production of iron pyrites .	Long ton	12,373		986	1,103	850		
United States :								
Production of iron pyrites .	Long ton	170,081						
Total imports (containing more than 25 per cent. sulphur) .	Long ton	276,385	63,210	26,979	14,923	6,365	63,351	29,140
QUICKSILVER								
Austria (Tyrol) :								
Production	Lb.	13,511	880	1,100	1,100	1,100	1,100	1,100
Czechoslovakia :								
Exports	Lb.	22,040	882	6,612	24,244	8,816	13,224	4,408
Italy :								
Production	Lb.	4,105,920						
Exports	do.	3,322,310	355,946	359,913	204,531	181,610	370,272	373,137
Rumania :								
Production	Lb.	7,879						
Russia :								
Production of ore . . .	Long ton		1,836	1,713	1,878	2,046		
Mexico :								
Production	Lb.	85,331	6,010	5,768	6,709	11,247	12,182	5,662
United States :								
Production	Lb.	688,050						
SILVER								
BRITISH EMPIRE								
Northern Rhodesia :								
Production	Fine troy oz.	(*a*)5,267	21	—	11	—	12	—
Southern Rhodesia :								
Production	Fine troy oz.	152,705	8,244	7,678	7,684	9,231	9,236	9,553

Union of South Africa (Transvaal):								
Sales and shipments in gold bullion	Fine troy oz.	934,254	78,567	74,589	82,691	80,408	82,373	82,069
Sales and shipments in other minerals	do.	225,815	—	—	—	—	—	—
Canada:								
Production in Ontario . .	Fine troy oz.	10,217,315 (b)	(c)774,116	(c)774,116	(c)774,116	(e)792,550	(e)792,550	(e)792,550
Silver content of ore, concentrates, etc., exported . .	do.	4,754,915	103,658	250,634	490,682	117,845	206,483	235,409
Silver bullion exported . .	Troy oz.	14,316,797	850,972	1,275,122	1,723,122	1,057,178	1,300,929	1,250,565
India (Burma):								
Production	Fine troy oz.	4,670,000	(c)434,114	(c)434,114	(c)434,114	439,337		
Australia:								
Production in:								
Queensland . . .	Fine troy oz.	286,516	(c)13,776	(c)13,776	(c)13,776	(c)29,411	(c)29,411	(c)29,411
Western Australia(d) . .	do.	59,075	137	15,493	53	1,689	18,456	23
Tasmania	do.	730,194	(c)48,102	(c)48,102	(c)48,102	(e)54,317	(e)54,317	(e)54,317
Commonwealth . . .	do.	10,211,615						
New Zealand:								
Exports of silver . . .	Troy oz.	495,268	36,865	17,176	43,847	43,287	35,928	77,952
PRODUCTION IN FOREIGN COUNTRIES								
Germany:								
Production	Troy oz.	4,501,000						
Italy:								
Production	Troy oz.	525,336						
Cuba:								
Production	Fine troy oz.	91,916						
Mexico:								
Production	Fine troy oz.	92,885,176	5,561,500	8,707,313	9,192,232	8,839,096	7,996,766	8,401,245

(a) *Including an adjustment for the period* 1920-1924 *inclusive.* (b) *The production for the Dominion was* 20,228,988 *fine troy ounces during* 1925.
(c) *Monthly average of first quarter,* 1926. (d) *Silver content of bars, slag, etc., exported from the State, not necessarily overseas.*
(e) *Monthly average of second quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
SILVER (*contd.*)								
United States :								
Production	Fine troy oz.	66,106,922	5,162,000	5,043,000	5,171,000	4,954,000	5,066,000	5,211,000
Bolivia :								
Quantity of ore exported	Cwt.	223,214	9,829		30,574	20,665	11,120	34,286
Silver content of ore exported	*Troy oz.*		*379,466*		*497,843*	*574,038*	*407,855*	*597,861*
Chile :								
Exports of ore	Cwt.	15,023	—	274	489	961	34	1,932
Exports of silver bullion	Troy oz.	300,828	—	34,554	21,239	13,834	33,321	—
Ecuador :								
Production	Fine troy oz.	78,000						
Peru :								
Production	Fine troy oz	20,888,400						
Exports of :								
Ore (*a*)	Cwt.	14,576	2,080	570	1,032	390	1,604	1,340
Concentrates (*a*)	do.	104,179	19,778	1,738	20,771	10,239	17,030	7,744
Sulphides (*a*)	do.	888	7	71	107	65	43	111
Silver bullion	Troy oz.	790,922	82,400	79,925	1,897	135,930	965	196,308
Silver scrap	do.	2,122	—	—	—	—	—	—
Japan :								
Production	Fine troy oz.	5,665,000						
SULPHUR								
BRITISH EMPIRE								
United Kingdom :								
Total imports	Long ton	109,545	5,221	9,481	11,816	8,876	3,523	7,753
Canada :								
Imports	Long ton	130,902	3,016	4,982	3,101	2,51[illegible]	4,483	35,412
India :								
Total imports from overseas	Long ton	12,337	1,529	1,839	2,342	1,276	338	1,720
New Zealand :								
Total imports	Long ton	19,982	4,221	1,958	2,3[illegible]4	2,769	4,513	46

Foreign Countries								
Belgium-Luxemburg E.U.:								
Imports	Long ton	9,288	594	946	529	596	1,257	1,941
Exports	do.	3,345	344	225	373	519	666	265
Czechoslovakia:								
Imports	Long ton	4,846	272	426	745	568	443	711
Finland:								
Total imports	Long ton	32,024	758	551	6	448	4,129	4,940
France:								
Imports of crude sulphur	Long ton	446,326	34,531	65,687	42,013	50,102	33,505	42,534
Exports of crude sulphur	do.	13,820	1,755	243	2,117	1,829	530	651
Exports of refined sulphur	do.	16,523	1,390	2,621	2,058	1,856	1,724	840
Germany:								
Imports	Long ton	103,817	10,586	2,633	8,537	7,460	7,185	5,090
Exports	do.	56,818	5,303	2,788	3,015	2,441	3,694	6,934
Italy:								
Production of crude fused sulphur	Long ton	259,355						
Production of crude ground sulphur	do.	26,813						
Exports of crude lump sulphur	Long ton	94,323	13,304	4,734	1,199	20,027	9,183	18,649
Exports of crude ground sulphur	do.	18,466	—	99	4,675	3,267	2,578	60
Exports of refined lump sulphur	do.	33,735	741	5,308	2,006	806	1,214	645
Exports of refined ground sulphur	do.	32,530	296	821	3,157	3,159	3,901	1,322
Exports of flowers of sulphur	do.	8,132	107	426			794	326
Norway:								
Total imports	Long ton	15,292	3,166	406	1,740	500	1,361	1,413
Sweden:								
Imports	Long ton	62,273	2,123	1,187	2,551	1,537	9,730	10,438
United States:								
Production	Long ton	1,409,240						
Exports of sulphur	do.	629,401	56,042	53,476	60,487	42,009	30,304	50,098
Exports of flowers of sulphur	do.	2,849	151	235	1,034	407	437	282

(a) *Silver is also contained in ores of base metals exported.*

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
SULPHUR (*contd.*)								
Japan :								
Production of sulphur rock	Long ton	46,000						
TIN								
BRITISH EMPIRE								
Great Britain :								
Tin content of ore produced	Long ton	2,348	(*a*)201	(*a*)201	(*a*)201			
Total imports of ores and concentrates	do.	64,124	8,052	4,670	4,042	6,497	4,103	4,943
Re-exports of ores and concentrates	do.	256	—	—	44	—	—	—
Exports of blocks, ingots, etc.	do.	25,758	2,074	2,457	1,906	1,388	2,456	3,082
Total imports of blocks, ingots, etc.	do.	15,919	2,119	1,232	1,624	1,351	599	1,156
Re-exports of blocks, ingots, etc.	do.	9,457	1,481	1,182	373	1,261	367	468
Nigeria :								
Approximate tin content of ore produced	Long ton	5,991	585	572	566	481	512	568
Southern Rhodesia :								
Tin content of ore produced	Long ton	17	—	—	—	—	5	—
South-West Africa Territory :								
Exports of ore	Long ton	218	17	23	15			
Swaziland :								
Production	Long ton	277						
Union of South Africa (Transvaal) :								
Tin content of marketable products	Long ton	1,157	118	83	90	97	97	82
Federated Malay States :								
Total tin content of exports	Long ton	45,925	3,963	3,546	3,501	3,667	3,692	4,074
By class :								
Tin in ore	do.	38,567	3,415	3,087	3,025	2,628	3,193	3,614
Tin	do.	7,358	548	459	476	1,039	499	460

By State :								
Perak	do.	30,748	2,687	2,371	2,311	2,445	2,456	2,653
Selangor	do.	13,104	1,100	1,021	994	1,108	1,061	1,257
Negri Sembilan . . .	do.	3	—	—	(c)	—	—	(c)
Pahang	do.	2,070	176	154	196	114	175	164
India :								
Tin content of ore produced .	Long ton	1,300						
Exports of tin ore overseas .	do.	1,887	157	165	192	96	84	131
Exports of tin overseas .	do.	353	—	—	44	50	50	106
Australia :								
Tin concentrates produced in (b) :								
Queensland :								
Lode	Long ton	674	(a)65	(a)65	(a)65	(e)55	(e)55	(e)55
Alluvial.	do.	335	(a)18	(a)18	(a)18	(e)27	(e)27	(e)27
Tasmania (tin content) .	do.	1,130	(a)67	(a)67	(a)67	(e)73	(e)73	(e)73
Western Australia (d) .	£	15,392	650	—	1,450	—	1,580	—
Exports of refined tin overseas from :								
New South Wales . .	Long ton	1,560	106	119	118	51	86	65
Victoria	do.	188	1	—	—	—	—	—
Exports of tin clippings overseas from :								
New South Wales . .	do.	1,036	89	210	211	267	360	220
Victoria	do.	2,264	90	287	468	165	266	150
Queensland . . .	do.	349	35	—	115	101	41	168
South Australia . .	do.	28	—	32	20	—	17	15
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports of ore	Long ton	1,369	205	33	34	115	30	(c)
Imports of unwrought tin and scrap	do.	1,128	85	81	85	123	66	98

(a) *Monthly average of first quarter,* 1926.
(b) *Tin content of ore produced in the Commonwealth during* 1925 *was* 3,016 *long tons ; smelter production was* 3,171 *long tons.*
(c) *Less than* ½ *ton.* (d) *Exports, not necessarily overseas.* (e) *Monthly average of second quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
TIN (*contd.*)								
Belgium-Luxemburg E.U. (*contd.*):								
Exports of unwrought tin and scrap	Long ton	748	15	43	142	59	119	207
Czechoslovakia:								
Imports of crude tin, tin alloys and scrap	Long ton	1,516	165	99	82	94	128	73
France:								
Production of tin-tungsten ore	Long ton	1,658	207	460	—	325	164	
Germany:								
Imports of ore . . .	Long ton	1,677	82	—	126	25	19	109
Imports of crude tin and scrap	do.	12,736	617	602	541	560	636	1,010
Exports of crude tin and scrap	do.	2,725	270	313	338	384	307	331
Exports of tin-foil . .	do.	257	36	27	42	58	30	29
Netherlands:								
Imports of crude tin and scrap	Long ton	1,174	115	89	68	91	59	99
Belgian Congo:								
Production of tin ore . .	Long ton	1,500						
United States:								
Total imports of bar, block or pig tin	Long ton	76,646	7,031	6,501	6,699	5,912	6,159	7,230
Re-exports of bar, block or pig tin	do.	570	65	137	170	102	173	36
Exports of bar, block or pig tin	do.	362	49	11	23	46	48	38
Bolivia:								
Exports of ore	Long ton	53,457	3,967		4,774	4,282	4,170	4,561
Tin content of ore exported .	*do.*	*31,500*	*2,333*		*2,718*	*2,553*	*2,410*	*2,638*
China:								
Tin content of shipments (*a*) .	Long ton	7,421	(*b*)247	(*b*)74	(*b*)286	(*b*)1,227	(*b*)223	(*b*)125
Dutch East Indies:								
Tin content of ore produced .	Long ton	32,749						
Shipments of Banca tin (*a*) .	do.	14,177	770	932	1,710	1,629	2,423	691

French Indo-China :								
Exports of tin-tungsten ore .	Long ton	464	29	66	20			
Exports of tin ingots . .	do.	321	23	19	30			
Siam :								
Tin content of ore produced .	Long ton	8,062						
ZINC								
BRITISH EMPIRE								
United Kingdom :								
Zinc content of ore produced .	Long ton	738	(*d*)85	(*d*)85	(*d*)85			
Smelter output	do.	42,000	(*c*)2,500	(*c*)2,500	(*c*)2,500	(*c*)2,500	(*c*)2,500	(*c*)2.500
Exports of spelter and wrought zinc, etc.	do.	5,393	350	390	302	358	376	588
Total imports of spelter .	do.	135,783	12,753	13,255	15,730	11,118	10,414	11,269
Total imports of wrought zinc, etc.	do.	18,410	1,416	1,586	1,617	1,549	1,146	1,602
Re-exports of spelter . .	do.	7,663	1,172	242	5	802	17	166
Northern Rhodesia :								
Smelter output . . .	Long ton	211	—	—	—	—	—	—
Canada :								
Zinc content of ore produced .	Long ton	48,780						
Exports of ore . . .	do.	43,161	—	—	—	—	—	2,330
Smelter output . . .	do.	34,358	4,105	3,854	4,694	4,623	4,874	4,496
Exports of spelter . .	do.	22,244	3,061	3,924	4,610	2,580	3,799	2,318
India :								
Production of concentrates in Burma	Long ton	16,600	(*d*)3,650	(*d*)3,650	(*d*)3,650	(*e*)4,323	(*e*)4,323	(*e*)4,323
Exports of spelter, etc., overseas	do.	20,967	3,030	2,950	6,261	4,020	1,000	8,500
Total imports of spelter, etc., from overseas . . .	do.	6,606	743	593	469	966	894	486

(*a*) *From 26th of previous month to 25th of month stated.*
(*b*) *To United Kingdom and United States only.*
(*c*) *Monthly average of first half-year*, 1926.
(*d*) *Monthly average of first quarter*, 1926.
(*e*) *Monthly average of second quarter*, 1926.

Particulars.	Unit	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
ZINC (*contd.*)								
Australia :								
Zinc content of ore produced in (*a*) :								
Queensland . . .	Long ton	171	—	—	—	—	—	—
Tasmania	do.	3,113	(*b*)270	(*b*)270	(*b*)270	(*d*)291	(*d*)291	(*d*)291
Exports overseas of ore, etc., from :								
Queensland (ore) . .	Long ton	462	—	—	—	121	—	—
South Australia (concentrates)	do.	181,844	12,482	21,039	17,967	31,180	23,706	34,183
Smelter output in :								
Tasmania	Long ton	42,976	(*b*)3,583	(*b*)3,583	(*b*)3,583	(*d*)3,868	(*d*)3,868	(*d*)3,868
Commonwealth . . .	do.	45,698	3,911	3,592	3,999	3,870	3,999	3,860
Exports of spelter overseas from :								
New South Wales . .	Long ton	2,864	2	999	—	1	—	—
Tasmania	do.	24,361	1,750	3,800	2,752	3,400	2,450	1,375
FOREIGN COUNTRIES								
Austria (Carinthia) :								
Production of ore . . .	Long ton	1,402	11	11	28	182	335	137
Belgium :								
Smelter output . . .	Long ton	179,130	13,254	14,572	16,018	15,418	15,520	15,280
Belgium-Luxemburg E.U. :								
Imports of ore . . .	Long ton	503,948	32,073	34,249	26,790	38,345	39,747	81,185
Exports of ore . . .	do.	21,749	1,179	3,398	1,720	3,665	1,158	6,097
Imports of spelter and scrap .	do.	7,924	732	410	325	243	509	235
Exports of spelter and scrap .	do.	81,057	6,032	7,662	9,499	8,430	5,067	8,158
Imports of sheets . .	do.	160	11	17	12	11	17	11
Exports of sheets . . .	do.	47,973	3,171	3,498	4,726	3,993	3,393	4,406
Czechoslovakia :								
Imports of ore . . .	Long ton	3,146	253	156	1,201	647	—	—

Exports of ore	do.	1,707	—	256	—	—	—	39
Imports of spelter and scrap	do.	16,069	664	1,111	1,192	1,015	529	1,037
France (*c*) :								
Production of ore	Long ton	14,528	2,909	4,061	1,342	1,368	935	
Imports of ore	do.	167,718	1,819	7,057	24,184	17,002	22,837	22,183
Exports of ore	do.	23,034	1,403	1,344	1,673	873	1,717	576
Imports of spelter, sheets and scrap	do.	45,628	4,737	4,951	4,694	3,175	5,869	3,051
Exports of spelter, sheets and scrap	do.	19,412	806	1,160	869	826	741	708
Germany :								
Imports of ore	Long ton	90,903	5,457	1,282	10,556	5,636	8,546	18,974
Exports of ore	do.	72,443	4,939	6,631	7,526	5,715	4,975	6,587
Smelter output	do.	57,705	4,799	4,451	5,170	5,092	5,485	5,471
Imports of spelter, dust, sheets, wire and scrap	do.	133,560	4,387	4,663	5,180	7,708	9,143	10,674
Exports of spelter, dust, sheets, wire and scrap	do.	26,662	3,324	3,024	2,806	1,726	1,800	1,914
Italy :								
Zinc content of ore produced	Long ton	67,779						
Exports of ore	do.	171,578	12,925	10,001	17,417	3,545	21,869	13,571
Smelter production	do.	6,374						
Imports of spelter, sheets, plates and scrap	do.	18,140	631	1,200	1,727	1,917	1,741	1,478
Netherlands :								
Imports of ore	Long ton	106,649	14,129	13,292	12,921	12,167	6,690	7,603
Imports of spelter and scrap	do.	3,237	369	316	355	287	321	423
Exports of spelter and scrap	do.	24,904	2,248	1,997	2,421	2,150	1,900	1,809
Imports of sheets, wire and dust	do.	7,244	508	483	665	767	918	730
Exports of sheets, wire and dust	do.	1,109	88	61	94	52	103	96
Russia (*c*) :								
Production of concentrates	Long ton		651	1,237	621	782		

(*a*) *Zinc content of ore produced in the Commonwealth during* 1925 *was* 138,783 *long tons.*
(*b*) *Monthly average of first quarter,* 1926.
(*c*) *See also under "Lead."*
(*d*) *Monthly average of second quarter,* 1926.

Particulars.	Unit.	Year 1925.	January 1926.	February 1926.	March 1926.	April 1926.	May 1926.	June 1926.
ZINC (*contd.*)								
Upper Silesia :								
Production of ore	Long ton	313,576	27,816	26,006	33,468	27,183	25,395	
Smelter output	do.	89,487	8,689	7,725	8,837	8,233	8,528	8,353
Algeria :								
Production of ore	Long ton	47,391	3,786	3,571	4,462	4,818		
Tunis :								
Production of ore	Long ton	19,196	1,771	2,460	1,733	1,968		
Mexico :								
Zinc content of ore produced .	Long ton	45,034	3,870	5,997	6,485	11,396	9,407	8,840
Smelter output	do.	1,255	500	462	524	510	494	400
United States :								
Zinc content of ore produced .	Long ton	636,000						
Shipments of Joplin ore .	do.	726,074	68,374	68,833	64,206	57,788	61,355	49,761
Total imports of ore . .	do.	12,086	189	3,147	1,453	1,001	128	452
Exports of ore and dross .	do.	75,874	8,582	7,539	9,674	20,996	6,727	12,437
Smelter output	do.	511,559	50,347	47,533	48,581	47,619	47,950	43,059
Exports of spelter, dust, sheets, etc.	do.	73,919	1,090	1,613	2,594	3,202	2,795	5,426
Bolivia :								
Exports of ore	Long ton	6,110	1,491		723	506	534	3,132
Zinc content of ore exported .	*do.*		*529*		*345*	*253*	*254*	*1,275*
French-Indo China :								
Exports of ore	Long ton	49,163	5,280	2,846	2,554			

PART A—PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial, and Indian Governments

GINGER AND GINGER PRODUCTS

SAMPLES of ginger, ginger peelings and ginger oil have been received at the Imperial Institute recently from different parts of the Empire, and an account of their examination is given in the following pages. References to the ginger-growing industries of certain countries are given in the article on ginger on pages 667–682 of this BULLETIN.

1. GINGER FROM SIERRA LEONE

A sample, stated to represent peeled ginger of Grade A of the current crop, was received from the Commissioner of Lands and Forests early in 1926. It was desired that reports on its quality and value should be obtained.

The sample consisted of 20 lb. of unlimed peeled ginger, in good sound condition. It was partly in hands up to 4 in. long, and partly in small pieces. The ginger was fairly plump, had a short, slightly fibrous fracture, and was cream-coloured on the outside and pale yellow internally. It was of good appearance and quality, and possessed a satisfactory aroma and pungency.

The ginger was submitted to several merchants and brokers for their opinions regarding its quality and probable market value.

All the firms consulted reported that the ginger was of good quality, and that commercial consignments of similar material would be readily saleable in this country. There was, however, some difference of opinion as to the

actual price likely to be obtained for shipments, and valuations were received ranging from 55*s.* to 67*s.* 6*d.* per cwt. c.i.f., with ordinary unpeeled African ginger at 45*s.* per cwt. c.i.f.

One of the firms of merchants stated that peeled ginger from Sierra Leone had already been brought to their notice, and that supplies had been offered to them at 65*s.* per cwt. c.i.f. They expressed the opinion that the product had been satisfactorily peeled, and would be readily saleable as a soft "cutting" ginger. It could be substituted to some extent by manufacturers for "cut" Cochin ginger, but this would only be possible in cases in which ginger of a lower quality could be used, since, however well it might be prepared, Sierra Leone ginger would not reach the quality of the Cochin variety. This firm recommended liming the hands, as is done in the cases of "cut" Cochin ginger, and grading to a higher standard of size by excluding the smaller hands and pieces.

The price which the ginger will eventually realise cannot be stated with any degree of accuracy at present, as the grade is new to the market. Its real value will doubtless be ascertained by the sale of the consignments which the Imperial Institute is informed are being prepared for the purpose.

This peeled Sierra Leone ginger had been well prepared and was of good quality. There is no doubt that shipments of such material would be readily saleable in the United Kingdom at prices considerably above that of ordinary unpeeled African ginger. If the ginger were limed and the larger hands were freed from the smaller hands and pieces, it would realise a still higher price as the appearance of the product would then more closely resemble that of "cut" Cochin ginger.

2. Ginger Peelings from Sierra Leone

A sample of ginger peelings was forwarded for examination to the Imperial Institute by the Commissioner of Lands and Forests in February 1926. It was desired to ascertain the quality and value of the peelings and the extent of the demand for such material in the United Kingdom.

The sample consisted of 51 lb. of thin, pale yellowish-brown, dry, shrivelled peelings, with very little of the interior of the ginger rhizomes attached to them.

The peelings were examined in order to determine the yields of essential oil and of extract.

Essential Oil.—A portion of the peelings, after having been ground fairly finely, contained 10·1 per cent. of moisture, and on distillation with steam yielded 4·0 per cent. of essential oil, equivalent to 4·4 per cent. on the moisture-free material. This yield is somewhat higher than is usually obtained from ginger cuttings, which generally furnish between 2 and 3 per cent. The oil was pale yellowish-brown and had a fairly good aroma.

The constants of the oil are given in the following table in comparison with those recorded for commercial oil of ginger :

	Present sample of oil.	Commercial oil of ginger.
Specific gravity at 15/15° C.	0·881	0·874 to 0·886
Optical rotation αD	− 43·75°	− 25° to − 50°
Refractive index $nD20°$	1·492	1·4885 to 1·4950
Acid value	1·5	0 to 2
Ester value	2·9	1 to 15
Ester value after acetylation	33·1	30 to 45
Solubility in 95 per cent. alcohol at 15° C.	1 in 4 or more volumes.	Up to 7 volumes and then not always clear.

These results show that the oil obtained from the ginger peelings has the normal characters of oil of ginger.

Extract.—On extracting the ground peelings with acetone and removing the solvent by distillation, a dark brown viscous extract was obtained, which had an intensely pungent taste and a good aroma. The yield of extract amounted to 12·5 per cent., equivalent to 13·9 per cent. on the moisture-free material. This yield is very satisfactory in comparison with that obtained from the East Indian cuttings usually employed for the purpose, which generally yield between 9 and 9·5 per cent. of extract.

Samples of the peelings were submitted to wholesale druggists, manufacturing chemists and essential oil distillers, and their observations may be summarised as follows.

The peelings would be saleable to manufacturing chemists for the preparation of extract (gingerine), or to

distillers for the production of essential oil. For these purposes the material would have to compete with ginger cuttings now imported from India. None of the firms, however, was able to assign a definite value to the peelings or to furnish an estimate of the possible demand.

One firm reported that the peelings gave a higher yield of extract than East Indian (Calicut) cuttings, and that the extract was of excellent appearance and of paler colour than that obtained from the latter material. The flavour and aroma, however, were considered somewhat inferior to those of the extract from Calicut cuttings.

Another firm expressed the opinion that the ginger peelings should realise about 15*s*. per cwt. less than Calicut cuttings, which were then selling at 75*s*. per cwt. (May, 1926). They mentioned that the market for the cuttings was weak, that prices were falling, and that the price mentioned should be regarded merely as an indication of the actual value. They added, however, that they would be glad to make a definite offer for a consignment, and suggested that, in the first place, a quantity of 10 to 20 cwts. should be forwarded in order that they might carry out a trial on a factory scale.

The results of this investigation have shown that the ginger peelings from Sierra Leone give good yields of essential oil and extract, and that these products are of satisfactory quality. The favourable reports which have been received from the trade indicate that the peelings would probably find a good opening in the United Kingdom, but it is not possible to report definitely on the commercial value until consignments have been sent for trial on an industrial scale. It was suggested, therefore, to the authorities in Sierra Leone, that a trial shipment of 10 to 20 cwts. should be forwarded in accordance with the offer of one of the firms consulted.

3. Ginger from Montserrat

A small sample of ginger was forwarded for examination to the Imperial Institute by the Curator, Agricultural Department, Montserrat, in May 1926.

The sample consisted of well-cut, dried ginger, in hands and small pieces, the former being up to 2¾ in. in length.

The ginger was in good, clean condition, rather fibrous, and of satisfactory aroma and pungency ; externally it was cream to brownish-cream, and pale yellow internally. The fracture was short and somewhat fibrous.

The ginger was examined with the following results, which are shown in comparison with the usual range of figures for commercial ginger, and with those specified in the *British Pharmacopœia* for ginger used for medicinal purposes.

	Present sample. *Per cent.*	Commercial ginger. *Per cent.*	*British Pharmacopœia* requirements. *Per cent.*
Matter soluble in water	16·4	about 10·0	not less than 8·5
Matter soluble in cold 90 per cent. alcohol	6·0	3·0—6·0	not less than 5·0
Total ash	3·5	3·0—6·0	not more than 6·0
Ash insoluble in water	1·47	—	not more than 1·5

It will be seen from the above table that with the exception of the matter soluble in water, which is rather higher than usual, the analytical figures for the present sample vary within the usual limits for commercial ginger ; they also satisfy the requirements of the *British Pharmacopœia*.

The ginger was regarded by commercial experts as being quite suitable for grinding and saleable at about 50*s.* to 55*s.* per cwt. c.i.f. London, with " good " Jamaica ginger quoted at 75*s.* per cwt. They stated that the ginger had been satisfactorily prepared, but that it was of mixed sizes, and contained a considerable proportion of small pieces.

The firm suggested that endeavours should be made to grow a bolder type of ginger, and added that the product might then be scraped rather more thoroughly than had been done in the present case, and also graded to remove the smaller pieces, which could be sold separately.

This Montserrat ginger was of satisfactory quality as regards pungency and aroma, but consisted of pieces of rather small and irregular size. Consignments of similar character would be readily saleable in the United Kingdom at fair prices, and the merchants who were consulted expressed their willingness to purchase 5 tons of ginger if supplies are available.

The suggestion of this firm that attempts should be

made in Montserrat to produce a bolder type of ginger appears to be worth consideration.

4. Ginger Oil from Seychelles

A small sample of ginger oil was forwarded for examination to the Imperial Institute by the Director of Agriculture in March 1926.

It was stated that the oil had been obtained experimentally, and that it was hoped to send a larger sample at a later date.

The sample consisted of a clear yellowish-brown oil, with a very good aroma.

On examination the oil furnished the following constants, which are compared with the corresponding values recorded for commercial oil of ginger :

	Present sample.	Commercial oil of ginger.
Specific gravity at 15/15° C.	0·905	0·874 to 0·886
Optical rotation, αD	− 22·4°	− 25° to − 50°
Refractive index $nD20°$ C.	1·494	1·4885 to 1·4950
Acid value	1·5	0 to 2
Ester value	22·5	1 to 15
Solubility in 95 per cent. alcohol at 15° C.	1 in 3 vols., becoming slightly cloudy on further dilution.	Up to 7 volumes and then not always clear.

From these results it will be seen that the present sample of ginger oil has an unusually high specific gravity, and gives a larger ester value than the ordinary commercial oil. It has a rather dark colour, but in view of its very good aroma it would probably be regarded as of good quality and approximate in value to the Jamaica oil which at the date of the report was quoted in London at 35*s*. per lb.

WASTE KAURI WOOD AS A SOURCE OF PAPER PULP AND RESIN

The possibility of utilising waste kauri wood as a paper-making material, either in its natural state or after the extraction of the resin which it contains, is being considered in New Zealand. In this connection samples of the wood

have recently been examined at the Imperial Institute in order to determine their suitability for paper-making. The question as to whether it would be profitable to de-resinate the wood before pulping would depend on the cost of extracting the resin and the market value of the product. Investigations have therefore also been carried out at the Imperial Institute regarding the nature and uses of the extracted resin. In addition, paper-making trials have been made with a sample of "fossil" kauri wood (from which the resin had been extracted by means of alcohol) in comparison with ordinary kauri wood.

1. Paper-making Trials with Waste Kauri Wood

The samples received at the Imperial Institute were described as follows:

"*No. 1. Green Stump. Young Tree.*" Weight 36 lb.

"*No. 2. Green Limb. Large Limb from Carter's workings.*" Weight 37 lb.

"*No. 3. Dry Stump.*" Weight 30 lb.

"*No. 4. Dry Limb from old worked-over areas.*" Weight 45 lb.

"*No. 5. Cross section of a young Kauri.*" Weight 80 lb.

Samples Nos. 1 to 4 consisted of air-dry rectangular blocks of wood of the dimensions 8 × 9 × 24 in. Sample No. 5, a cross-section from a young trunk, arrived in a rather damp condition.

Representative portions of the samples were analysed with the following results, which are expressed on the material as received, except in the case of No. 5, which was air-dried before examination.

Sample.	Moisture.	Ash.	Resin.		Cellulose.	
			Expressed on wood as received.	Expressed on moisture-free wood.	Expressed on wood as received.	Expressed on moisture-free wood.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
No. 1 .	12·8	0·3	7·8	8·6	45·7	52·3
No. 2 .	11·3	0·3	7·1	8·0	45·7	51·4
No. 3 .	8·5	0·3	14·1	15·4	45·5	49·8
No. 4 .	9·1	0·8	19·9	21·9	40·1	44·1
No. 5 .	13·3	0·9	1·7	2·0	53·4	61·5

The dimensions of the ultimate fibres present in the samples are given in the following table:

—	Length in mm.			Diameter in mm.		
	Range.	Mostly between.	Average.	Range.	Mostly between.	Average.
No. 1 .	2·9 to 7·1	4·0 and 5·4	4·5	0·020 to 0·0787	0·0355 and 0·061	0·0440
No. 2 .	2·7 to 7·2	4·0 and 5·6	4·5	0·0286 to 0·0762	0·0355 and 0·0635	0·0487
No. 3 .	2·7 to 7·0	4·0 and 5·9	5·0	0·020 to 0·0787	0·0355 and 0·0635	0·0432
No. 4 .	2·7 to 6·9	4·0 and 5·6	4·4	0·020 to 0·0762	0·0355 and 0·066	0·0434
No. 5 .	2·5 to 6·9	3·9 and 5·8	4·4	0·020 to 0·0762	0·0355 and 0·066	0·0449

The so-called felting powers (diameter : length) of the fibres were as follows:

No. 1, 0·010; No. 2, 0·011; No. 3, 0·009; No. 4, 0·010; No. 5, 0·010.

Paper-making trials were carried out with each of the five woods as received and also with two of the woods (Nos. 1 and 4) after the extraction of the resin.

Untreated Wood

In each case the wood, after being reduced to chips, was treated with caustic soda solution under conditions similar to those employed for the production of paper-pulp on a commercial scale. The results are expressed in all cases on the air-dry wood.

Sample.	Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry p[...]	
		Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached.	Ble[...]
				hrs.	°C.		*Per cent.*	*Per cent.*
No. 1	A	20	4	6	160[1]	12·0	43	—
	B	20	4	7	160[1]	11·8	43	41
	C	24	4	7	160[1]	13·6	40	38
No. 2 .	A	24	4	7	160[1]	13·4	38	34
No. 3 .	A	24	4	7	160[1]	13·4	35	33
No. 4 .	A	24	4	7	160[1]	12·1	33	29
No. 5 .	A	24	4	7	160[1]	14·5	43	39

[1] *Equivalent to 75 lb. per sq. in.*

In the case of No. 1 the conditions employed in Trial A

were not sufficiently severe to reduce the wood thoroughly, and a certain amount of incompletely disintegrated material therefore remained in the pulp. Paper made from this pulp was yellowish-brown, and of excellent strength. The conditions of Trial B were still scarcely severe enough to yield a homogeneous pulp, although the paper produced was slightly better than that obtained in Trial A ; the pulp, however, could not be satisfactorily bleached, owing to the presence of the coarse particles still present. The best results were obtained in Trial C, and the conditions used in this case were also found to be the most suitable for each of the other samples. The additional quantity of soda used proved just sufficient to yield a well-reduced homogeneous pulp, which furnished a yellowish-brown paper of excellent strength. The pulp did not bleach well, but furnished a pale cream-coloured paper of excellent strength and quality.

The pulps obtained from samples Nos. 2, 3, 4 and 5 were very similar in strength and quality to that obtained from No. 1. The colour of the unbleached pulps from Nos. 2 and 5, however, was somewhat darker than in the case of the other samples ; the pulp from No. 5 was more difficult to bleach than that from any of the other samples and yielded a pale buff paper.

De-resinated Wood

In order to compare the behaviour of the wood after removal of the resin with that of the wood containing the resin, pulp-making trials were carried out with chips of wood from which most of the resin had been extracted by prolonged digestion with boiling alcohol or acetone.

The woods selected for these experiments were No. 1 ("Green Stump of a Young Tree") which contained 8·6 per cent. of resin, and No. 4 ("Dry Limb from old worked-over areas") containing 21·9 per cent. of resin (expressed in each case on the moisture-free wood). After extraction these woods contained 1·7 and 0·5 per cent. of resin respectively (also expressed on the moisture-free wood).

The de-resinated chips were treated with caustic soda solution under conditions similar to those employed in the

experiments with the untreated wood, and furnished the following results:

Sample.	Trial.	Moisture.	Caustic soda used. Parts per 100 parts of wood.	Caustic soda used. Parts per 100 parts of solution.	Conditions of digestion. Time.	Conditions of digestion. Temp.	Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp. Unbleached.	Yield of dry pulp. Bleached.
					hrs.	°C.		*Per cent.*	*Per cent.*
No. 1[1]	A	10·4	20	4	6	160	11·6	55	—
	B	10·4	24	4	7	160	12·6	47	45
No. 4[2]	A	8·7	24	4	7	160	11·0	46	44

[1] *Extracted with alcohol.* [2] *Extracted with acetone.*

In the case of No. 1 the conditions of Trial A were not sufficiently severe to produce a well-reduced pulp, and the paper obtained was similar in character to that produced in the corresponding Trial A with the original wood. A satisfactory pulp was, however, obtained in Trial B, the conditions of which were those previously found to give the best results with the original woods. The pulp did not bleach readily, but it yielded a paper of excellent strength and quality.

The de-resinated wood No. 4 also gave a satisfactory pulp under the same conditions, but this again could not be easily bleached.

These experiments show that the de-resinated woods furnish pulps similar to those obtainable from the original woods under the same conditions, with a reduction of about 1 per cent. in the amount of soda consumed. The yields of pulp were very satisfactory and compare favourably with those obtained commercially in the manufacture of ordinary soda wood pulps.

Summary of Results

The results of these trials with the five samples of kauri wood are summarised in the following table, which shows the conditions for pulping which proved the most satisfactory. In order to facilitate comparison the yields of pulp, the soda consumption and the percentages of resin present are expressed in each case on the wood containing 10 per cent. of moisture.

Original (Untreated) Wood.

Sample.	Trial.	Resin.	Caustic soda used. Parts per 100 parts of wood.	Caustic soda used. Parts per 100 parts of solution.	Conditions of digestion. Time.	Conditions of digestion. Temp.	Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp. Unbleached.	Yield of dry pulp. Bleached.
		Per cent.			*hrs.*	°C.		*Per cent.*	*Per cent.*
No. 1	C	7·7	24	4	7	160	14·0	41	39
No. 2	A	7·2	24	4	7	160	13·6	39	35
No. 3	A	13·9	24	4	7	160	13·2	34	32
No. 4	A	19·7	24	4	7	160	12·0	33	29
No. 5	A	1·8	24	4	7	160	15·0	45	41
De-resinated Wood.									
No. 1	B	1·7	24	4	7	160	12·6	47	45
No. 4	A	0·5	24	4	7	160	10·8	45	43

General Remarks

This investigation has shown that the five samples of kauri wood when treated by the soda process under similar conditions of digestion yielded paper pulps of almost exactly the same quality. The conditions necessary to produce bleachable pulps were somewhat severe, and the soda consumption was rather high, except in the case of No. 4.

The pulps were composed of coarser and longer fibres than those of commercial coniferous wood pulps, and furnished papers of excellent strength. They did not bleach satisfactorily with the amount of bleaching powder which suffices in the case of spruce pulp, but furnished pale cream-coloured papers.

The yields of pulp varied with the amount of resin in the wood ; sample No. 5, which contained less than 2 per cent. of resin, yielded 45 per cent. of unbleached pulp, whereas sample No. 4, containing 19·7 per cent. of resin, yielded 33 per cent. The specimens of Nos. 1 and 4 from which most of the resin had been extracted required similar conditions of digestion to those found necessary for the original woods, but consumed a somewhat smaller quantity of soda. The yields of pulp obtained from these de-resinated woods are very satisfactory.

The results show that kauri wood represented by the present samples could be converted into paper-pulp of satisfactory quality, either in the original condition or after removal of the resin. In the case of samples 3 and 4,

however, where a large quantity of resin is present in the wood, it is possible that owing to the comparatively low yield of pulp the manufacture might not prove remunerative unless the resin could be extracted and marketed at a satisfactory price. It seems possible that wood containing less than 10 per cent. of resin might be converted into pulp without previous de-resination, but that it might be advantageous to remove the resin from wood containing 10 per cent. or more before pulping.

It has been suggested to the New Zealand authorities that observations might be made with a view to determining whether any relation exists between the percentage of resin in the wood and the age of the trees, or other factors. It might facilitate the treatment of the wood if it could be roughly separated into two groups, one of which could be pulped in the original condition, whereas the other might need de-resination in order to make its treatment remunerative.

2. Paper-making Trials with "Fossil" Kauri Wood

This sample of wood was stated to consist of "fossil" kauri wood, from which much of the resin had been extracted by means of alcohol.

The sample consisted of yellowish-brown chips which varied considerably in size. On sifting the material, 43 per cent. of the sample was retained on a ½-in. sieve; 48 per cent. passed this sieve, but remained on a ⅛-in. mesh sieve; and the remaining 9 per cent. passed the ⅛-in. sieve. The larger chips were reduced to approximately the same size as those which passed the ½-in. mesh sieve and remained on the ⅛-in. sieve, and the two portions were then thoroughly mixed and employed for the investigations described in the following pages. The fine material which passed the ⅛-in. sieve was discarded.

The sample thus prepared was analysed with the following results:

	Expressed on material as received. *Per cent.*	Expressed on moisture-free material. *Per cent.*
Moisture	9·7	—
Ash	0·59	0·66
Cellulose	35·9	39·7
Resin	10·0	11·1

The material was treated with caustic soda solution under similar conditions to those employed for the production of paper-pulp on a commercial scale. The results, which are shown in comparison with those obtained at the Imperial Institute with the samples of waste kauri wood, both before and after de-resination, are given in the following table, the results being expressed in all cases on the wood containing 10 per cent. of moisture.

Sample.	Resin.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
		Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Un-bleached.	Bleached.
	Per cent.			*hrs.*	°C.		*Per cent.*	*Per cent.*
Sample of "fossil" wood[1] . . .	10·0	20	4	7	160	12·2	30·0	28·0
Samples of the waste wood:								
No. 1 . .	7·7	24	4	7	160	14·0	41·0	39·0
No. 2 . .	7·2	24	4	7	160	13·6	39·0	35·0
No. 3 . .	13·9	24	4	7	160	13·2	34·0	32·0
No. 4 . .	19·7	24	4	7	160	12·0	33·0	29·0
No. 5 . .	1·8	24	4	7	160	15·0	45·0	41·0
De-resinated wood:								
No. 1[2] . .	1·7	24	4	7	160	12·6	47·0	45·0
No. 4[3] . .	0·45	24	4	7	160	10·8	45·0	43·0

[1] *Partially de-resinated by means of alcohol.*
[2] *Extracted with alcohol.* [3] *Extracted with acetone.*

The digestion of the present sample with 20 parts of caustic soda per 100 parts of wood at 160° C. (equivalent to a pressure of 75 lb. per sq. in.) yielded a homogeneous pulp which furnished a strong, pale brown paper of good quality. The pulp could not be bleached satisfactorily, the palest colour obtainable being a deep cream. The bleached paper was otherwise of good quality and excellent strength.

This investigation has shown that the present material, consisting of chips of "fossil" kauri wood, is capable of producing paper of good quality and strength, which is generally similar to that obtained at the Imperial Institute from fresh waste kauri wood.

It will be observed that although the wood had been extracted with alcohol it still contained 10 per cent. of resin, and this would account to some extent for the low

yield of pulp. The yield obtained was, however, distinctly lower than those furnished by samples of fresh kauri wood containing similar amounts of resin. This is probably attributable to the difficulty in regulating the conditions of digestion in such a way as to avoid uneven attack when the size of the chips vary so largely as in the present case; it is probable that the treatment was too severe for some of the smaller fragments, and that this caused a reduction in the weight of pulp. A better yield would doubtless have been obtained if the chips had been of a fairly uniform size (say about 1 in. × 1 in. × ½ in. thick).

The fine material which passed the ⅛-in. sieve would yield pulp inferior to that obtained from the larger pieces, owing to the fact that many of the fibres had been broken. It is doubtful whether this portion could be profitably employed, but, in any case, it would have to be treated apart from the larger chips as the conditions of digestion required for the latter would be too severe.

3. Nature and Value of the Extracted Resin

It will be seen from the table on p. 655 that the waste kauri wood received at the Imperial Institute (with the exception of that obtained from a young kauri tree) contained from 7 to 20 per cent. of resin.

It was found that the resin could be best extracted from the wood by means of acetone, ethyl alcohol or methyl alcohol. The resin thus obtained was dark brown and had a melting point of about 70° to 73° C. It was completely soluble in the solvents mentioned above, and almost completely in amyl alcohol; it was only partially soluble in oil of turpentine, benzene, ether, chloroform and dilute solutions of caustic soda and ammonia, and almost insoluble in light petroleum.

Varnishes were prepared with equal weights of the extracted resin and alcohol. When applied to sized wood they dried rapidly, giving tough, hard, rather dark-coloured, lustrous coats which showed no sign of cracking after several weeks' exposure.

On distillation with steam, the resin yielded only a trace of volatile oil (about 0·1 per cent.) which was solid

at the ordinary temperature and possessed a characteristic, not unpleasant odour.

A further quantity of the resin was extracted from the kauri wood for submission to commercial firms for technical trial and valuation ; this furnished constants which are shown below in comparison with the range of figures recorded for fossil kauri resin.

	Resin extracted from kauri wood.	Fossil kauri resin.
Softening point ° C. . .	64	60–90
Melting point ° C. . .	72–74	150–185
Acid value	41	71–79
Saponification value . .	124	73–89

On melting, the resin can be pulled out into long elastic threads, and in this respect resembles shellac.

Samples of the resin were submitted to two firms of varnish manufacturers, to a firm of linoleum manufacturers, and to a firm of merchants for opinions as to its possible uses and value.

One of the manufacturing firms reported that the properties of the resin somewhat resembled those of fossil kauri gum, but that it possessed elastic properties. They considered that the resin could be used as a partial substitute for shellac in varnishes and other wood-finishing materials, and regarded it as worth about 90*s.* to 100*s.* per cwt.

The second firm of manufacturers stated that the resin would be unsuitable for oil varnishes as it is incompletely soluble in hot linseed oil, and that owing to its dark colour and insolubility in certain solvents it would only be of low commercial value. The firm offered to carry out further tests to determine the value more definitely if a large quantity could be supplied for the purpose.

The linoleum manufacturers stated that in order to determine whether the resin could replace fossil kauri gum for their purposes it would be necessary for them to carry out extensive practical trials with some hundredweights of the material. They suggested, however, that the resin might possibly be worth about £10 per ton in advance of American F.G. rosin, the price of which was then abnormally high (£34 per ton—October, 1926).

The merchants who were consulted reported that as the resin is incompletely soluble in linseed oil and in turpentine it would be of no use as a substitute for gum copal, but that it might serve as a substitute for shellac. The value of the resin would depend on whether it will yield similar varnishes to those prepared from shellac, but they expressed the opinion that it might possibly realise a price of 80*s*. per cwt. ex-wharf, London.

The results of this investigation indicate that the resin extracted from waste kauri wood would be saleable in this country, and might realise a price of about 80*s*. to 100*s*. per cwt. It must be borne in mind, however, that these valuations are only tentative, and that a definite opinion cannot be given until technical trials have been made by manufacturers on a larger scale. It was pointed out to the New Zealand authorities that if, in view of the results given in this report and of those of the paper-making trials, it is considered worth while to proceed further with the object of utilising this kauri wood for the manufacture of paper-pulp, with the extracted resin as a by-product, it will be necessary for at least 5 cwts. of the resin to be extracted, either in New Zealand or in this country, in order that complete technical trials may be carried out to determine definitely its commercial value and possibilities.

It may be mentioned that the resin extracted from the fossil kauri wood is superior to that described above (which was obtained from the waste wood) and more resembles the ordinary kauri gum of commerce.

CASCARA BARK FROM KENYA COLONY

The experimental cultivation of cascara bark (*Rhamnus Purshianus*) is being undertaken in Kenya Colony by the Forestry Department. Seed, obtained from California, was sown at Nairobi in 1919. The trees grew fairly fast, and commenced to bear seed in their third year; when five years old they had reached a height of 6–7 ft. Seed collected at Nairobi has been distributed to Forest Stations at higher altitudes, in order to determine the suitability of these situations for the tree.

The Department are considering the possibility of extending the cultivation of the tree as a native industry, and in order to ascertain the quality of the bark grown at Nairobi the Conservator of Forests forwarded a small sample to the Imperial Institute in 1924, when the trees were five years old.

The sample consisted of straight, stiff quills of bark, 16 to 20 cm. long, and from 0·5 to 3 cm. in diameter. On the outer surface the bark was purplish-brown, fairly smooth, and marked with transversely elongated pale brown lenticels. The inner surface was dark reddish-brown, and showed longitudinal striations.

The product was rather thinner than ordinary commercial cascara bark, and was free from the lichens which are usually present on the latter.

The bark was found to contain 7·8 per cent. of moisture and to yield 4·7 per cent. of ash ; the aqueous extract amounted to 27 per cent. These figures agree with those given for cascara bark in the *British Pharmaceutical Codex*.

The powdered material gave with caustic soda the strong purple colour characteristic of cascara bark.

Samples of the bark were submitted to manufacturing druggists and to drug brokers in London for their opinions.

The manufacturing druggists stated that the sample had been carefully collected, and was of particularly good appearance. It was pointed out, however, that trials would be necessary in order to determine whether the East African bark is as active medicinally as cascara bark from other sources. If these trials gave satisfactory results the bark might be expected to realise the current market price.

The brokers stated that this East African bark differs in appearance from the commercial Californian bark, and that buyers would, therefore, not be disposed to purchase it freely in the first instance. In view of this fact they were of opinion that it would be necessary to offer it at a lower price until it became established on the market. They recommended that a small shipment of bark from the present trees should be forwarded for trial sale before any steps are taken to extend the cultivation.

This cascara bark from Kenya was of promising character and the Imperial Institute suggested that a quantity of the bark should be forwarded for therapeutical trials in order to establish its quality in comparison with the cascara bark from other sources.

In accordance with this suggestion 18 lb. of the bark collected in February, 1925, was forwarded by the Conservator of Forests. The quills ranged in length from 15 to 37 cm., but were mostly between 25 and 30 cm. In general, the bark resembled the earlier sample, but was rather thinner.

On examination the bark furnished results which are shown below in comparison with those yielded by the previous sample, and those given for cascara bark in the *British Pharmaceutical Codex*.

	Present sample from Kenya Colony.	Previous sample from Kenya Colony	Figures given in the *British Pharmaceutical Codex*
	Per cent.	*Per cent.*	*Per cent.*
Moisture	7·8	7·8	—
Ash	5·0	4·7	about 5
Aqueous extractive	25·7	27·0	about 27

When treated with caustic soda solution the bark gave the strong purple coloration characteristic of cascara bark.

These results indicate that the bark resembled the previous sample in the respects mentioned, but yielded slightly less extractive matter.

Therapeutical trials.—After the bark had been stored for one year, in accordance with the requirements of the *British Pharmacopœia*, it was forwarded to a firm of manufacturing druggists, who prepared a liquid extract from it of the strength prescribed by the Pharmacopœia. This extract was forwarded to St. Thomas's Hospital, the authorities of which had kindly offered to carry out trials in order to ascertain whether the extract was as active medicinally as that made from cascara bark from other sources.

These trials were duly carried out at the Hospital and the following report has been furnished to the Imperial Institute :

" The specimen of liquid extract of cascara was

entrusted to the Medical Unit, so that it might be fully tried by the same physicians. Extensive trial has been made on both male and female adult cases of the liquid extract of cascara from bark grown in Kenya Colony, as supplied by you.

"The report on its action is entirely favourable. Both Dr. Jones and Dr. Forest Smith report that there has been no sign of sickness, and its purgative action is indistinguishable from that of the liquid extract, which we have been in the habit of using, made from American bark.

"This report, therefore, seems to be entirely favourable to the development of this drug."

General Remarks

The results of this investigation have shown that the cascara bark produced in Kenya Colony is of good quality and equal in medicinal activity to the bark obtained from the United States. The bark should, therefore, be readily saleable when available in commercial quantities, and it would appear that the cultivation of the tree for the production of bark might well be encouraged in the Colony.

ARTICLE

GINGER: ITS CULTIVATION, PREPARATION AND TRADE

THE bulk of the world's supplies of dried ginger is at present produced within the Empire, in the West Indies, India and West Africa. Jamaica ginger is of a relatively uniform high grade. Indian ginger is on the whole of somewhat lower quality, although certain kinds, such as Calicut ginger, realise prices approaching those of Jamaica ginger. The ginger produced in Sierra Leone, however, which forms a very large proportion of the material imported into the United Kingdom, is of a lower grade. The Imperial Institute is informed that the United Kingdom market could absorb increased supplies of ginger of the better qualities, and for this reason it has been considered desirable to draw the attention of present and potential producers to the best methods of cultivating the

plant and preparing the product for the market. In the case of Sierra Leone and Dominica this has already been done to some extent by means of a memorandum sent recently by the Imperial Institute to the respective Governments of those countries. Through the agency of the present article, it is hoped to create an interest in the product in other parts of the Empire, where the conditions are suitable for its production.

The Ginger Plant

The ginger of commerce consists of the underground stem or rhizome of a herbaceous perennial, *Zingiber officinale*, Roscoe, belonging to the natural order Zingiberaceæ, a section of the Scitamineæ. The rhizome is branched and bears at intervals upright leafy shoots, about 2 ft. high, and, usually distinct from these, an erect flowering shoot.

From very early times the plant has been grown from cuttings of the rhizome and, like certain other plants which are propagated entirely by vegetative means, such as the banana, fertile seed is rarely produced. The cultivated plant consequently shows little variation in botanical characters and the various forms of ginger which appear on the market owe their differences almost entirely to the method of cultivation and preparation practised in the region of production. It was at one time stated that the relatively juicy Canton ginger, from which the Chinese preserved ginger is prepared, was derived from a distinct though related plant, *Alpinia galanga*. This, however, is now known to be erroneous, and the succulence and slight pungency characteristic of Chinese ginger appear to be due to the special methods of cultivation adopted in China and to the rhizome being harvested at a comparatively early age (see p. 674).

The original home of the ginger plant is not known with certainty. It occurs wild in South-east Asia and in the Malay Archipelago, and it has also been recorded in a wild state in Colombia. It has been suggested, however, that the plants found in Colombia are relics of early cultivation, as may possibly be the case also in the other two regions mentioned.

PLATE III.

Photo [E. Wells Elliott, Kingston, Ja.

GINGER PLANTS

Showing the Underground Rhizomes

Cultivation and Preparation

Climatic Requirements

For the successful cultivation of ginger the essential requirements as regards climate are a good rainfall and a high temperature during the growing period. In the ginger-growing region of Jamaica the mean annual rainfall is 88 in., whilst in south-west India it is over 100 in. A dry season during the resting period and prior to planting is an advantage, as it facilitates the thorough preparation of the soil required for the crop, but is not essential.

Owing to the fact that a high temperature is needed for the optimum growth of the plant, cultivation is naturally most successful in tropical and sub-tropical regions. It need not be restricted to such areas however. Provided that the heat and sunshine are sufficient during the greater part of the year, a cold winter is immaterial, as before this period is reached the rhizomes will have been dug up from the ground, the bulk already prepared for the market and the remainder stored for planting the following season. These are actually the conditions obtaining round Canton and also in parts of Queensland where the crop is grown.

As regards altitude the plant succeeds in Jamaica from sea-level to considerable elevations, and in India also it is grown both in the low country and up to 4,000–5,000 ft. in the Himalayas.

Soil and Manure

Ginger is an exhaustive crop and, unless manures are readily and cheaply available, the soil in which it is grown must be rich in plant food. The plant will not succeed in land liable to become water-logged or in soil of a gravelly or very sandy nature. The most suitable kind of soil, therefore, is a rich vegetable loam. The land must be well drained, as if water collects about the rhizome the latter is liable to rot.

The best varieties of Jamaica ginger are grown on a sandy loam, and in India the ginger produced on the compact black soils is said to be inferior to that grown on the lighter sandy loams. The amount of sand should

probably be not more than 30 per cent., and of clay not above 20 per cent.

In Jamaica the primitive plan of clearing forest lands by fire was largely followed, and on this cleared land ginger was grown until the soil became exhausted, when it was abandoned and a new piece of land put into cultivation. This wasteful method resulted in the production of large tracts of exhausted land, which could only be brought under cultivation once more after considerable expenditure on chemical manures. In order to avoid this objectionable way of using land, experiments were carried out by the Jamaica Agricultural Society with a view to ascertaining the most suitable manures for ginger. A mixture composed of marl, with 10 per cent. each of soluble phosphates, ammonia, and potash salts, applied at the rate of one ton per acre, gave the best results. On worn-out land a yield equivalent to 2,960 lb. of ginger per acre was obtained with this manure, whilst on the unmanured, exhausted land the plants hardly grew, and gave no return.

In most parts of India manuring is regularly practised, the manures generally employed being oil-cake and dung. In some parts old and well-decayed cow-dung is either applied at the time of the first ploughing or is put in the holes made when planting the crop. During growth the ground is sometimes top-dressed with mustard-cake and castor-cake, whilst the mulch of leaves, etc., often applied to the ground after planting, also serves to enrich the soil.

The principal constituents removed from the soil by ginger are stated to be lime and phosphoric acid, and it is the replacement of these constituents which should be aimed at.

Cultivation

In Jamaica two methods of cultivation are adopted. That by which the best ginger is obtained consists in planting in March or April portions of selected rhizomes from the previous year's crop, care being taken that each portion planted contains an "eye" (embryo stem). The land is raised into ridges and the pieces of rhizome are placed a few inches below the surface and about

one foot apart, the process being much the same as that observed in planting potatoes. It is advisable thoroughly to clear the land of weeds before planting the rhizomes, as the removal of weeds becomes difficult later on when the ginger plants have developed. Unless the rainfall is good it is necessary to resort to irrigation, as the plants require a good supply of water. The ginger produced in the foregoing way is known as " plant ginger."

" Ratoon ginger " is obtained by leaving in the soil from year to year a portion of a rhizome containing an " eye." This " eye " develops in the normal way, giving rise to a supply of rhizomes in the succeeding season. " Ratoon ginger " is smaller and contains more fibre than " plant ginger," and the product obtained by this means is said to deteriorate steadily from year to year.

In some parts of India it is usual to plant the crop in beds about 10 to 12 ft. long and 3 or 4 ft. wide, in which the sets are placed about 9 in. to 1 ft. apart. The field is then covered over with the leaves of trees or other green manure to keep the soil moist, and over the leaves organic manure is spread to a depth of about ½ in. At the end of the rainy season it is necessary to resort to irrigation. During the first three months of the dry season the field is weeded about three times.

Before planting, the land must be thoroughly hoed (or ploughed) and harrowed, in order to produce a fine tilth. In planting large fields it would appear preferable to open up drills about 4 in. deep and 2 ft. apart, much as is done in planting potatoes on a large scale. Artificial manure, such as superphosphate and bone meal, can then be incorporated in the soil at the bottom of the drill, before planting the sets.

On account of the crop taking up such large quantities of plant food a system of rotation should be adopted if possible. This is done in some parts of Jamaica, where much of the ginger is grown in small quantities as a garden plant, in association with bananas, chillies, etc.

The method of growing ginger in the Canton district of China differs considerably from that practised in countries where dried ginger is the objective. Low-lying ground is usually selected for the crop and the cuttings are set

at intervals of 6 in. in ridges about 1 ft. high and 2 ft. apart. Water is kept continuously between the ridges. After the shoots have reached a height of from 6 in. to 1 ft. the plants are heavily manured at frequent intervals with urine or nightsoil mixed with water. This favours the formation of the succulent rhizome characteristic of Chinese ginger.

"Ratoon ginger" matures early, and in Jamaica is harvested from March to December; but "plant ginger" is not ready for digging until December or January, the rhizomes being gathered as they mature from that time until March. The rhizomes are known to be ready for digging when the stalks wither, this taking place shortly after the disappearance of the flowers. In Jamaica the plant flowers during September. The rhizomes are twisted out of the ground with a fork or a hoe. In performing this operation great care is necessary, as any injury inflicted on the rhizome depreciates its market value. Considerable experience is necessary in order to lift ginger rhizomes properly.

The "hands" (complete rhizomes and adherent fibrous roots) are piled in heaps, the fibrous roots are broken off, and the soil and dirt removed immediately, as otherwise it is difficult to get the finished ginger white. The rhizomes should not be allowed to lie long in heaps, as they are liable to ferment. The usual plan is, as soon as the rootlets and excess of soil have been removed, to throw the ginger into water to be ready for "peeling" or "scraping." This is done in Jamaica by means of a special knife, consisting merely of a narrow straight blade riveted to a wooden handle; in India the outer skin is scraped off with a shell or piece of broken earthenware. In the case of Sierra Leone ginger of the ordinary grade the flat sides of the hands are scraped with a spoon and the hands are then laid out to dry without washing in water.

The operation of peeling, if carried out in a proper manner, is a very delicate one, the object being to remove the skin without destroying the cells immediately below it, since these cells contain much of the oil upon which the aroma of the best qualities of ginger depends.

As the rhizomes are peeled they are thrown into water and washed; and the more carefully the washing is done the whiter will be the resulting product. As a rule the peeled "hands" are allowed to remain in water overnight. Some planters in Jamaica add a small proportion of lime-juice to the wash water at this stage, at the rate of about half a pint to six or seven gallons of water, in order to produce a whiter root.

After washing, the peeled rhizomes are placed in a "barbecue," which consists merely of a piece of levelled ground covered with cement, on which the ginger is placed to dry in the sun. Where a "barbecue" is not available, a "mat," consisting of sticks driven into the ground, across which are laid boards or palm or banana leaves, is used, on which the ginger is exposed until it is dry. Uniform drying of the rhizomes is essential for the production of first-class ginger and to prevent mildew; and to ensure this they should be separately turned over by hand at least once on the first day. Careful planters put their ginger out daily at sunrise, and take it in each night at sundown; conducted in the latter way the operation of drying usually takes from six to eight days. The ginger, if not sufficiently white in appearance, has to be bleached by further washing, and after being re-dried is ready to be packed for export. In some parts of India the peeled rhizomes are bleached by soaking in lime-water for a short time and exposing them for about 12 hours after drying to the fumes of burning sulphur in a specially constructed bleaching-room, at the rate of 7 lb. of sulphur per ton of rhizomes.

The finished ginger is graded according to size and colour of the "hands"—the best grades consisting of the large plump "hands" free from traces of mildew, and the poorest the shrivelled, dark-coloured "hands." As a rule the crop is divided into four or five grades. The best "hands" obtained in Jamaica weigh as much as 8 oz., 4 oz. being an average weight.

Unpeeled ginger is merely freed from its rootlets and excess of soil, and then thoroughly washed in water or scalded in a boiler of hot water, and finally dried in the sun.

Preparation of Preserved Ginger.—In China the first crop of ginger is ready about three months after planting. This is known as "young ginger" and is the least pungent and most expensive. Unlike the Jamaica and Indian ginger, the rhizomes are not allowed to mature, as they become too pungent for the purpose for which they are required. After harvesting the roots are washed and the skin carefully scraped off. They are then punctured by means of a fork and afterwards washed in rice water (the water left after washing rice) to improve the colour. The rhizomes are next boiled in three or four changes of refined sugar and water for one or two hours, until thoroughly soaked. They are then placed in barrels or other containers and covered with syrup. In the case of dry preserved ginger, the wet rhizomes are strained till dry and then rolled in sugar placed on bamboo matting.

Yield

The yield of ginger varies considerably with the climate, soil, and methods of cultivation employed. In Jamaica the average return is from 1,000 to 1,500 lb. of dried ginger per acre, but as much as 2,000 lb. per acre has been obtained under the best conditions. The recorded yields in different parts of India vary within wide limits. In Bengal it is stated that 1,000 to 1,500 lb. per acre is the average crop, in the Punjab 2,100 lb., in Travancore 2,000 to 2,500 lb., whilst in an experimental cultivation at Surat, Bombay Presidency, the yield was equivalent to over 8,000 lb. per acre. As already mentioned, a yield equivalent to nearly 3,000 lb. per acre was obtained in Jamaica on exhausted land by the application of a suitable manure; and there is no doubt that, by careful cultivation and manuring, the yield in all the countries mentioned could be considerably increased. It takes about 4 tons of freshly dug rhizomes to give 1 ton of dried ginger.

Pests and Diseases

Owing to the pungent nature of the shoots, the ginger plant is attacked by very few insect pests, and it has even been recommended that the crop should be planted in orchards to prevent the development of pests of fruit

trees. At the Rangpur Agricultural Station, Bengal, however, the larva of a Drosophelid fly, which lives on coarse grasses, has been observed to do a good deal of harm to the shoots.

In Southern India the caterpillar of a butterfly, *Udaspes folus*, sometimes does great damage to the leaves, whilst the caterpillar of a moth, *Dichocrocis punctiferalis*, bores into the stem and rhizome, but seldom does serious harm. The latter is better known as a pest of castor plant in Southern India. In Travancore the rhizome is bored by the larva of a small fly (*Calabota* sp.) which deposits its eggs at the base of the plants; when the crop is gathered the larva migrates to wild arrowroot, where it completes its development. The best remedy is stated to be the destruction of the alternative food plant.

The coconut scale, *Aspidiotus destructor*, has been found to occur on ginger in Fiji, but no information appears to be on record as to the extent of the damage caused.

Considerable injury is inflicted on ginger crops in Jamaica by a disease called "black rot," which attacks the underground parts of the plant, and brings about decay of the rhizomes. The first indication of the disease is a yellowing of the leaves, which droop and wither; the bases of the stems become discoloured and rot, and finally decay spreads to the rhizomes, which disintegrate to form a putrefying mass of tissue. A fungus present in the decomposing rhizomes was found to form spores in a similar manner to *Allantospora radicicola*, Wakker, a fungus which causes a root disease of sugar-cane in Java. It was not clearly shown, however, that the fungus found in the old rhizome was the cause of the disease (Howard, *Bull. Bot. Dept. Jamaica*, 1901, **8**, 181; 1902, **9**, 42).

A similar rot of the rhizome, caused by a species of Pythium, which occurs in India, was first recorded by Butler from Surat and is described by McRae in *Agric. Journ. India* (1911, **6**, 139). The disease spreads rapidly through the soil, and to prevent infection of healthy plants every portion of an affected plant must be removed and burnt, whilst the soil itself should be treated with lime, or a light dressing of sulphate of iron may be applied. Isolation of infested soil by a trench has been tried with

success, but in the case of a bad attack ginger should not be grown on the land for at least three years. The disease is most serious on wet, heavy soils, or in exceptionally rainy seasons, and it may be prevented to a large extent by draining the land, so that no water lies round the collar of the plant. Great care should be exercised in selecting only healthy rhizomes for planting purposes, any plants with even the slightest trace of disease being rejected. After a bad attack it is advisable to steep the rhizomes for about half an hour in Bordeaux mixture before planting, to destroy any fungus spores or hyphæ on their surface or in the soil clinging to them. The fungus, which also occurs on tobacco and papaya in India, was at first thought to be *Pythium gracile*, Schenk, which in Europe is found on freshwater algæ. Subramaniam, however, showed that it is a distinct species, which he calls *Pythium Butleri* (*Mem. Dept. Agric., India, Bot. Ser.*, 1919, **10**, 181).

Another disease of ginger which does some damage in Jamaica is locally called "cork rot." This cannot be detected until the crop is gathered, when the rhizomes are found to be of cork-like texture and quite valueless. The exact nature of this disease does not appear to have been investigated.

A new disease of ginger, caused by *Vermicularia Zingiberæ* and reported from the Godaveri District, is described by Sundararaman in *Mem. Agric. Journ., India, Bot. Ser.* (1922, **11**, 209). The disease begins with small yellowish spots and later the whole leaf turns yellow and rots, resulting in a poor development of the rhizome. It makes rapid progress during a period of continued wet weather and high humidity, but the advent of drier conditions checks its growth and the plant may recover. Spraying with Bordeaux mixture was found to be effective against the disease.

Uses of Ginger

For flavouring purposes ginger is perhaps the most widely used of all spices. It is employed whole in the preparation of various confections, chutneys, pickles and the like, and in the ground condition for a great variety of purposes. Large quantities are used in the manufacture of ginger beer, ginger ale and similar

beverages. Its medicinal value is well known, the root being used chiefly as a stomachic and internal stimulant, especially in flatulency and colic. The pungency of ginger is due to the presence of a resinous substance and the odour to an essential oil. The latter is separated by steam distillation and used to some extent in perfumery. The characters of the oil are dealt with in this BULLETIN (pp. 651, 654) in connection with reports on a sample of ginger peelings from Sierra Leone and on a sample of the oil received from Seychelles.

In connection with the attempts being made to improve the quality of Sierra Leone ginger, the Imperial Institute recently made enquiries regarding the uses of the various types of ginger, the results of which may be here summarised.

Unscraped (unpeeled) ginger is used as a cheap substitute for peeled ginger for most of the purposes for which the latter is usually employed. When peeled ginger is relatively cheap less unscraped ginger is used in this way whilst, on the other hand, more of it is used when peeled ginger commands a high price. A certain amount of unscraped ginger is also employed by distillers in the United Kingdom, who prefer it to peeled or scraped ginger, because it contains rather more essential oil. In the latter connection it was considered that the peelings might also find a market amongst distillers, and a sample was obtained from Sierra Leone for investigation at the Imperial Institute, the results of which are given on page 650 of this BULLETIN.

For certain purposes only peeled ginger is suitable, e.g. for the "whole ginger" sold by grocers, for the best grades of ground ginger and for the best kinds of ginger beer. Unscraped ginger is sometimes used for the lower qualities of ground ginger, but not commonly for ginger beer. For medicinal use, "scraped" ginger alone is official in the British Pharmacopœia, but both peeled and unpeeled may be used for official preparations in the United States.

Ginger from no one country is in demand exclusively for any particular purpose. The peeled ginger from Jamaica, Cochin and Japan is all used for the same purposes, the grade of ginger employed depending on the

quality of the article to be produced. Unscraped varieties from different sources are generally interchangeable.

Trade and Production of Ginger

Chief Consuming Countries

The bulk of the dried ginger produced in Jamaica, India and Sierra Leone is taken by Great Britain and the United States. The quantity and value of the imports into this country in pre-war and recent years were as follows: 1912, 65,529 cwts., £131,645; 1913, 39,275 cwts., £72,812; 1921, 23,597 cwts., £73,694; 1922, 38,855 cwts., £128,985; 1923, 30,054 cwts., £131,252; 1924, 46,877 cwts., £210,199; 1925, 50,370 cwts., £186,753. The imports from the various producing countries in 1924 (the latest year for which figures are available) are shown in the following table:

Country whence consigned.	Quantity. cwts.	Value £
Sierra Leone	17,291	61,483
British India	16,288	69,491
British West Indies	7,263	53,387
Other British possessions	296	1,341
Foreign countries (including re-exports from the United States)	5,739	24,497
Total	46,877	210,199

The quantity of dried ginger imported into the United States in 1912–13 amounted to 69,251 cwts., valued at $399,270. Since the war the maximum imported in any year was 52,955 cwts. ($604,659) in 1922, whilst in 1925 the amount was 38,083 cwts. ($609,542). These figures include a large import from Great Britain. Of the imports received direct from the country of origin the bulk was supplied from British West Africa.

Producing Countries

Jamaica.—As already indicated, ginger is grown in Jamaica by the natives in small plots as a garden crop. There is no extensive area under cultivation. It is grown mainly at an elevation of about 2,000 ft., chiefly in the central districts of the island, on the borders of the parishes of Manchester, Clarendon, Trelawny and St. Elizabeth, whilst it is also grown in the northern part of West-

moreland and in the hills of St. James. The production fell off in the years following the war as compared with pre-war years, but showed a notable recovery in 1925. The exports over a series of years are shown in the following table:

Year.	To United Kingdom.	To United States.	To Australia.	To Canada.	Total Exports.	Total Value.
	cwts.	*cwts.*	*cwts.*	*cwts.*	*cwts.*	£
1912 . .	13,212	9,300	255	1,989	25,214	48,038
1913 . .	9,847	8,700	—	2,084	20,638	36,374
1921 . .	2,577	6,932	72	1,900	12,361	63,350
1922 . .	5,532	6,552	373	482	13,162	90,161
1923 . .	5,939	8,171	1,414	1,064	17,184	112,601
1924 . .	7,132	5,722	612	1,791	15,407	93,669
1925 . .					21,297	68,684

India.—The chief producing areas of India are the Malabar coast (Calicut and Cochin), the Surat and Thana districts of the Bombay Presidency, the Rangpur district in Bengal, and the Kumaon district of the United Provinces. As in the case of Jamaica, the plant is grown in small plots by the natives, and no estimate of the total area under cultivation is possible. Ginger is very largely consumed in India, but the exports are considerable, although in recent years they have shown a marked falling off in quantity. The total exports from India over a series of years are shown in the following table:

	Quantity.	Value.
	cwts.	
1912–13	88,845	£158,425
1913–14	82,273	£122,661
1921–22	74,463	Rs. 19,61,106
1922–23	51,946	Rs. 17,79,851
1923–24	45,065	Rs. 20,34,425
1924–25	36,778	Rs. 20,46,243
1925–26	32,566	Rs. 17,50,998

The bulk of the Indian ginger is shipped from ports in Bombay and Madras. That from Bombay is much inferior in quality to the Southern India ginger and goes chiefly to Aden for re-export to neighbouring countries. The ginger shipped from Madras on the other hand goes mainly to Great Britain and the United States, although a considerable quantity also goes to Ceylon. In 1924–25 the share of Bombay in the total Indian exports was 23,636 cwts., whilst that of Madras was 11,696 cwts.

(6,374 cwts. to Great Britain, 2,132 cwts. to the United States and 1,051 cwts. to Ceylon).

Sierra Leone.—The cultivation of ginger was started in Sierra Leone shortly after the settlement there of the liberated slaves. It is probable that the roots were brought over from Jamaica. At first the crop was planted only in the Colony, but later its cultivation spread to the Protectorate whence the bulk of the ginger has been supplied in recent years.

As far back as 1874 (the earliest year for which records are available) 16,610 cwts. of ginger were exported from Sierra Leone, a figure which is greater than that reached in many subsequent years including so recent a year as 1921 The lowest export on record was in 1892 when 8,622 cwts. were shipped. Taking a series of years, however, there has been on the whole a general increase in the exports, until in 1925 the record export of 49,260 cwts. was reached, ginger ranking third in the list of domestic exports in that year.

Great Britain was the principal market for Sierra Leone ginger until 1916, when the conditions brought about by the Great War diverted about 13,980 cwts. to the United States. The latter country has since that date been the chief purchaser of Sierra Leone ginger, except in 1925, when shipments to Great Britain slightly exceeded those to the United States. In 1926 shipments were made to South Africa for the first time and it is probable that Sierra Leone will supply, in future, the bulk of South Africa's requirements. Canada also is now a consumer of Sierra Leone ginger.

The exports of ginger from Sierra Leone during the last three years have been as follows :

Chief Countries of Destination.	1923.		1924.		1925.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	cwts.	£	*cwts.*	£	*cwts.*	£
United Kingdom .	3,416	6,552	13,641	36,524	24,920	62,200
United States .	24,384	39,594	24,839	68,387	21,411	51,670
France . .	—	—	—	—	2,229	4,744
Total exports .	27,905	46,236	38,847	105,633	49,260	119,742

Since the Colony took up the production of ginger for

export, only one quality has been exported, viz. the ordinary roughly scraped ginger, until 1926, when some 15 tons of peeled ginger, prepared under instruction of the Lands and Forests Department, were shipped and sold in London. Peeled ginger of this kind was also exhibited by the Sierra Leone Government at the Canadian National Exhibition in 1926, and was favourably reported on by consumers who tested it.

Other Countries of the Empire.—Ginger has been grown for local consumption, or experimentally, in many other British countries, including Malaya, Ceylon, Fiji, Queensland, St. Lucia, Barbados, Montserrat, and Dominica, but none of these is at present of commercial importance as a source of the spice. It is also being grown experimentally, as previously mentioned, in Seychelles, but more as a source of essential oil than for the preparation of the rhizomes. The question of extending the cultivation in Dominica and preparing a product of the grade of Jamaica ginger is under consideration, and a sample examined recently at the Imperial Institute was of promising quality and of a kind that would be readily saleable in Great Britain (see this BULLETIN, 1925, **23**, 276).

Japan.—In view of the fact that Japanese ginger is regularly quoted in the London and New York markets, brief reference to its production may be made. The plant is cultivated in most parts of the country as a garden crop, but more especially in the Shizuoka and Wakayama prefectures. During 1917 and 1918 the exports of dried ginger amounted to 6,378,000 lb. and 7,883,000 lb. respectively, but in the two following years they fell to 1,101,000 lb. and 691,000 lb. Since 1920 ginger has not been shown separately in the Japanese trade returns, but some idea of the output can be gauged by the imports into the United States and India, the two chief customers for Japanese ginger. Whereas in 1918 the imports into the United States amounted to 1,807,625 lb., the maximum since then has been only 469,579 lb. in 1923; in 1924 they were as low as 34,465 lb. India, in 1917–18, imported 2,286,368 lb. of ginger from Japan; the imports fell to a minimum of 45,472 lb. in 1921–22, and were 945,392 lb., 1,340,752 lb. and 818,944 lb. in 1922–23, 1923–24 and 1924–25 respectively.

Market Prices

The following table shows the fluctuations of prices in London in recent years:

Grade.			Price per cwt. 1924.	1925.	1926 (up to October).
Jamaica	Good to Fine	Highest	170s.–185s.	150s.–180s.	135s.–145s.
		Lowest	170s.–180s.	135s.–145s.	85s.–95s.
,,	Ordinary to Medium	Highest	145s.–170s.	135s.–145s.	125s.–130s.
		Lowest	140s.–160s.	120s.–130s.	60s.–75s.
Calicut	Cut A Medium to Fine Bold	Highest	135s.–145s.	145s.–150s.	145s.–150s.
		Lowest	120s.–125s.	135s.–145s.	145s.–150s.
,,	B and C, Small and Medium	Highest	120s.–130s.	130s.–140s.	130s.–140s.
		Lowest	100s.–115s.	120s.–130s.	120s.–135s.
Cochin	Rough, Common to Fine Bold	Highest	85s.–95s.	95s.–105s.	95s.–102s. 6d.
		Lowest	80s.–90s.	95s.–102s. 6d.	60s.–85s.
,,	Small and Ds	Highest	90s.	90s.	75s.
		Lowest	70s.–75s.	75s.	50s.
Japan	Unsplit	Highest	100s.	100s.	80s.
		Lowest	90s.	82s. 6d.	55s.
African	Ordinary	Highest	90s.	85s.–87s. 6d.	52s. 6d.
		Lowest	82s. 6d.	58s.	32s. 6d.

The prices ruling in New York during 1924, 1925 and 1926, expressed in cents per lb., were as follows:

Grade.			Price per lb. 1924.	1925.	1926 (up to October).
Jamaica	Fancy, Bold	Highest	38½–39½	32 –33	22 –23
		Lowest	32 –33	22 –23	20 nom.
,,	Dark, Grinding	Highest	33½–34	26½–27	17½–18
		Lowest	26½–27	17½–18	13½–14
,,	Medium	Highest	35 –36	27½–28	18 –19
		Lowest	27½–28	18 –19	14½–15½
Cochin	A.B.C.	Highest	25½–26	25 –25½	19 –19½
		Lowest	18½–19	18½–19	13 –13½
Japan		Highest	19 –20	20 –21	20 –21
		Lowest	17½–18	19 nom.	13 –14
African	No. 1	Highest	20 –20¼	19½–19¾	15¼–16
		Lowest	15¼–15½	14¼–15	8¼–9

It will be seen that, with the exception of the Calicut ginger and the better grade of Cochin ginger marketed in London, there has been a general fall in the price of ginger. This is more pronounced in the case of African than any other sort.

NOTES

Their Majesties at the Imperial Institute. Their Majesties the King and Queen visited the Imperial Institute on the 15th December and were received by Mr. Arthur Michael Samuel, Parliamentary Secretary to the Department of Overseas Trade, Sir William Clark, Comptroller-General of the Department of Overseas Trade, and Lt.-Gen. Sir William Furse, Director of the Imperial Institute. Their Majesties made an extensive tour of the newly decorated and reorganised Exhibition Galleries of the Institute which contain a display of economic products of the Empire, together with newly constructed dioramas illustrating the activities, industries and scenery in the various Dominions and Colonies.

The Director subsequently received the following letter from Lord Stamfordham.

BUCKINGHAM PALACE,
15 *Dec.*, 1926.

" DEAR SIR WILLIAM FURSE,

It was a great pleasure to the King and Queen to-day to re-visit the galleries of the Imperial Institute. Their Majesties were much interested in the transformation already made in the galleries and feel confident that, when this change is realised by the public, and more especially by the Education Authorities, the fullest advantage will be taken of the opportunities now afforded by the new Board of Governors. The new and beautiful dioramas with the accompanying exhibits offer an attractive and stimulating education in the scenery, activities and development of our Dominions, India and the Colonies. The King and Queen were also gratified to know that, by an arrangement between the Board of Governors and the Council of the Royal Commission for the Exhibition of 1851, an Imperial Gallery of Art has been set aside for the exhibition of the Scholarship Work of the British School at Rome, and of the work of contemporary artists from every part of the Empire, at home and overseas.

Yours very truly,
(Signed) STAMFORDHAM.

Lieutenant-General
Sir William Furse, K.C.B.,
Director,
Imperial Institute.

The Imperial Conference and the Imperial Institute.—The Research Special Sub-Committee which was set up by the Imperial Conference considered, among other questions, two memoranda on the Imperial Institute, the first dealing

with the reorganisation of the Institute and the second containing notes on the progress made and work done since the reorganisation.

In their report to the Conference the Sub-Committee note that the amalgamation of the Imperial Institute and the Imperial Mineral Resources Bureau has been duly carried out and that the work of reorganisation is now in a large measure completed; that the Exhibition Galleries have been redecorated and relighted, and the exhibits modernised in a manner which, it is believed, will add greatly to their instructional value both for schools and for the general public; and that steps are being taken to bring the Institute into closer touch with the work being done in other parts of the Empire, especially in relation to tropical and semi-tropical agriculture, and generally to improve its machinery for the collection and dissemination of scientific and technical information.

At the final meeting of the Imperial Conference the following resolution, as recommended by the Research Sub-Committee, was adopted:

Imperial Institute:

> "The Conference approves the steps taken to carry out the recommendations of the Imperial Economic Conference of 1923 for the reorganisation of the Imperial Institute, and expresses its satisfaction at the progress which has been made since the reorganisation."

Agricultural Industry of Malta.—The Maltese Islands form a group south of Sicily near the centre of the Mediterranean Sea. The only two of any importance are Malta itself, which is about 17 miles in length and 9 miles in breadth, with an area of slightly under 95 sq. miles, and Gozo, to the north-west, which has an area of about 26 sq. miles. The total civilian population at the 1921 census was 212,258, of whom 189,697 resided in Malta and 22,561 in Gozo. The Maltese, who speak a language akin to Arabic, are an industrious people. The islands are highly cultivated, 16,263 people being employed in agriculture; a large number of the inhabitants are employed in connection with the trade of Valetta as a coaling station, and an entrepôt and port of call. The following particulars relating to the agriculture of the islands are taken from the *Report of the Superintendent of Agriculture* for 1925–26.

The total agricultural area is estimated at 42,964 acres; of this 905 acres is mostly too poor for cultivation, but a small part of it is reclaimed each year and brought under

cultivation. There is no pasture land in the ordinary sense, as the land is too valuable to be devoted exclusively to grazing, particularly as it would remain bare and unproductive for the greater part of the year, owing to the long summer drought. The number of holdings is estimated at about 11,000, giving each an average area of less than 4 acres.

Most of the produce is grown for home consumption, but there is a small export of early potatoes, cumin seed, onions, cotton and oranges.

The area under wheat in 1925–26 amounted to 9,378 acres, an increase of 671 acres over the preceding year, whilst the production is estimated at 38,736 quarters (about 870 tons), showing the excellent yield of 33 bushels per acre. The varieties grown are all hard wheats, the most common being the so-called Red Hard Wheat and Yellow Hard Wheat. A black-eared, yellow-grained wheat is also extensively cultivated. Improved varieties, including Susa or Medeah wheat and Dreadnought (of Australian origin), are being distributed from the Government Experimental Farm and are gaining favour with growers.

Barley was grown on an area of 5,878 acres, a slight decrease as compared with 1924–25. This figure includes 2,212 acres of " meslin " or " mischiata," a mixed crop of wheat and barley grown chiefly in Gozo, and used principally for fattening pigs. The yield is estimated at 32,231 quarters, including 11,463 quarters of " meslin."

In Gozo and the West District of Malta, maize is grown as a catch crop after the main winter crops have been harvested. Abundant rains in the spring of 1925 favoured summer cultivation and as a consequence maize was grown on 1,110 acres, giving an estimated yield of 2,990 quarters, as compared with 242 acres and 951 quarters in the previous year. In the other districts of Malta, maize as a catch crop was almost entirely superseded by sesame, which is usually grown in only small quantities. In 1925–26, however, sesame was grown on 758 acres, with an estimated yield of 1,042 quarters.

Potatoes are extensively grown in Malta and large quantities are exported, chiefly to the Netherlands, Italy, Germany and the United Kingdom. In 1925 shipments amounted to 11,008 tons, valued at £119,831. The winter crop of potatoes consisted of 2,798 acres, with an estimated yield of 8,570 tons, whilst spring and summer potatoes were grown on an area of 4,589 acres, the production being estimated at 19,318 tons. Potato blight was very virulent throughout the island, but with the

advice and assistance of the Department of Agriculture, spraying with Bordeaux mixture is becoming general.

The season was a favourable one for the growth of onions and 1,031 acres were planted with this crop, the estimated yield being 7,860 tons. In 1925 the exports of onions amounted to 29,858 cwts., valued at £10,471, the chief customers being Netherlands and Italy.

Cumin seed is grown entirely for export and is seldom, if ever, used in the local industries. The production in 1925 fell off considerably as compared with the previous year, the respective figures being 10,776 cwts. from 1,758 acres, and 23,762 cwts. from 4,330 acres. The reduction in the acreage is attributed to the low prices realised during the previous year. The exports of cumin seed in 1925 amounted to 13,381 cwts., valued at £32,242.

Cotton is grown in Malta as a dry-farmed summer crop, and owing to the favourable spring of 1925 already referred to, it was grown on a larger scale than in the previous year. The total production in 1925 was 312,840 lb. of lint from 1,628 acres as compared with 229,328 lb. from 965 acres in 1924. Cotton spinning and weaving, which at one time were flourishing industries in the islands, are now virtually extinct, the number of persons engaged in these occupations, according to the report on the 1921 Census, falling respectively from 9,753 and 4,693 in 1851 to 262 and 221 in 1921. Almost the whole crop is therefore exported, the figure for 1925 being about 270,000 lb., valued at £11,465, which was sent to Italy, the United Kingdom and Netherlands. The ordinary Maltese cotton is a form of *Gossypium herbaceum* and has a short staple, but an Upland long-stapled variety introduced by the Department of Agriculture is regarded with favour by growers who have taken up its cultivation.

Owing to the absence of ordinary pasture land, very large quantities of green forage are grown for feeding livestock, the total area under such crops in 1925 being 11,258 acres. The chief plants grown for this purpose are sulla (*Hedysarum coronarium*), vetches, caterpillar-plant (*Scorpiurus subvillosus*) and green barley.

Although citrus trees are grown on a fairly large scale, the production falls far short of the demand, the imports, almost exclusively from Sicily, amounting in 1925 to 1,090,000 dozen fruits. The local production of citrus fruits in 1925 amounted to 178,490 dozen. There was a small export of 11,012 dozen of oranges and mandarines in that year, mainly to the United Kingdom.

Grape-growing and the production of wine from the fruits is already a fairly important industry, but is capable

of considerable expansion. The area of vineyards in 1925 was 1,712 acres and the production was estimated at 140,235 cwts. of grapes, the bulk of which was manufactured into wine.

The Utilisation of South African Timbers.— Investigations which are being carried out in South Africa by the Forest Department, in association with the Timber Committee of the South African Railways and Harbours, on the suitability of South African timbers for rolling stock construction and other purposes, are referred to in the latest reports of those bodies (*Annual Departmental Reports, Union of South Africa, No.* 5, *for* 1924–25, pp. 405–407, and *Report No.* 15 *of the Timber Committee for* 1925).

The Timber Committee, while recognising the beauty and usefulness of many South African woods, refer to the practical difficulties which lie in the way of utilising them in railway workshops and state that improper seasoning is probably the greatest obstacle to their use. The yellow woods (*Podocarpus elongata*, *P. Thunbergii* and *P. falcata*), which are soft woods, stand pre-eminent among local timbers, both on account of supplies and general utility, and when properly seasoned they can be successfully employed for many purposes in railway work. Most of the hard woods, from considerations of ultimate cost, appear to have comparatively little prospect for railway purposes, but in some cases, e.g. white pear (*Apodytes dimidiata*), it is considered that the timbers will find special uses.

Timber seasoning experiments are being carried out by the Forest Department, on behalf of the Committee, in the Experimental Kilns at Pretoria. During 1924-25 trials were carried out with twelve species of timber, including common yellow wood (*Podocarpus elongata*), Camdeboo stinkwood (*Celtis rhamnifolia*), white ironwood (*Toddalia lanceolata*), white pear, and chemnen (*Afzelia quanzensis*). Both fan and water spray kilns were employed. Chemnen shrank remarkably little and the timber used in the experiments was afterwards utilised with complete success for the joinery of the railway coaches used by H.R.H. Prince of Wales during his tour in South Africa.

It is interesting to note that kiln-seasoning by private firms is notably on the increase in South Africa.

The preservative treatment of timber has also been investigated at the Wood Preservative Station of the Forest Department.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important, recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

FOODSTUFFS

Bananas.—The final report of the Investigation Committee appointed by the Bunchy Top Board of Control, Australia, on the occurrence of the bunchy top disease in Australia is reviewed in *Queensland Agric. Journ.*, (1926, **25**, 506). The report refers in detail to the huge losses which the disease has inflicted in New South Wales and Queensland, and states that the spread of the disease was primarily due to the propagation of infected suckers and to natural transmission by the banana aphis, *Pentalonia nigronervosa*. Since the investigators decided that no measures of protection, no resistant or immune banana stock, and no remedial methods are available, the only means for controlling bunchy top are legislative measures of restriction. The proposals include the destruction of affected plants, the registration of all banana, plantain and Manila hemp plantations, and the destruction of all backyard or garden plants in unregistered places; also various restrictions on the transport and sale of banana suckers, and the imposition of various other responsibilities on the Governments and growers. It is considered that the continuous full co-operation of all concerned in carrying out these comprehensive recommendations will result in the restoration of the industry in heavily affected areas to its former status.

Sugar Cane.—In an article on the mosaic disease of sugar cane in India in 1925 by W. McRae, the officiating Imperial Mycologist, which appeared in *Agric. Journ. of India* (1926, **21**, 198), the symptoms of the disease and its history are briefly reviewed. The disease, which was first described in Java in 1892, was not observed in India till 1921, and extensive search was then made in the most likely districts. The writer considers, however, that mosaic disease is not a new introduction into India, but that it has existed among the thin canes of Northern India for a long time. During 1925 it appeared in epidemic form throughout a large tract of Northern India on Hemja,

the commonly grown indigenous cane. The canes introduced and selected by the Agricultural Departments during the last twenty years, and those produced in Coimbatore during the last few years, have been so carefully observed that it is difficult to believe that the presence of mosaic disease on them would have remained undetected for any length of time. It seems probable that where these new canes have subsequently shown the disease it was transmitted to them from Hemja. The disease is probably endemic in India, and Hemja is probably tolerant.

Oils and Oil-seeds

Coconuts.—In the Philippine Islands there is only one company which manufactures refined, deodorised coconut oil, and this is used by them in the preparation of a lard substitute and margarine. In the process of manufacture the oil is deodorised by blowing super-heated steam through it under reduced pressure. The temperature employed ranges from 177 to 248° C., the pressure is 25 in., and the duration of the process from nine to ten hours. This steam treatment removes volatile matter, which condenses to a whitish or greyish, greasy, malodorous substance which slowly turns darker on exposure to the air. The nature of this material changes as the process proceeds. At the beginning it is a very greasy, oily liquid; after three hours solid white particles appear, while as the end of the process approaches this solid whitish substance predominates. Brooke (*Phil. Journ. Sci.*, 1926, **30**, 201) has examined the nature of the volatile matter, and has found it to consist of acidic saponifiable and unsaponifiable substances. Most of the products of the last-named group distil over in the first four hours, and were found to contain compounds of an alcoholic nature. Coconut oil was shown to occur in the saponifiable substances. Methyl nonyl ketone was isolated, its identification being confirmed by the preparation of its oxime, di-oxime and semicarbazone.

There were eight hundred cases of coconut palms suffering from bud-rot on the west coast of Porto Rico in 1923–24 (*Journ. Agric. Res.*, 1926, **32**, 471). The earliest symptom of this disease is the wilting and death of the youngest leaf, followed by the falling of the surrounding leaves, thus leaving the palm without a central column of green leaves. Finally the old leaves fall away slowly until the trunk is completely defoliated. Infection occurs by the penetration of the disease into the growing point, laterally through the leaf bases or vertically in

the central column of leaves. The organism that is responsible for this disease is a small chlamydospored strain of *Phytophthora faberi*, Maublanc. The incubation period of the disease varies from three to nine months or in some cases longer. The following experiments were carried out on the inoculation of coconut palms with a culture of the causal organism. Six unwounded palms were inoculated laterally on tender leaf bases. Three succumbed to typical bud-rot. Of six wounded palms which were inoculated laterally all died of the disease. When three unwounded trees were inoculated laterally on tough leaf bases, no infection resulted. In another series of experiments the inoculation was effected by pouring an aqueous suspension of the fungus among the young leaves. Seven out of the eight inoculated died of bud-rot. Inoculation experiments showed that the bacteria that are always associated with the fungus in cases of bud-rot are not themselves capable of producing the disease.

In Porto Rico the palms attacked by bud-rot exhibit the earliest symptoms most frequently in November and December at the end of the rainy season. Young, protected palms and those in low moist situations are especially susceptible to the disease. The wind and possibly insects are considered to be the principal disseminating agents. Trials have shown that the destruction of affected palms is effective as a control measure.

Ground-nuts.—The marketing of ground-nuts is dealt with in *Bull. No.* 1401 (1926), *U.S. Dept. Agric.* Three types of the nuts are commercially important in the United States, namely, the large-podded Virginia, the large-podded Runner and the small-podded Spanish. Virginias sold in the shell reach the consumer in the roasted form. Shelled Virginias and shelled Spanish appear on the market as salted peanuts, peanut candy and peanut butter. Shelled Runners are used by some butter and candy manufacturers as a substitute for shelled Virginias, and when prices do not justify shelling Runners are bought by crushing mills. Under certain market conditions Spanish nuts are also crushed. Ground-nut oil is used in the United States chiefly in the manufacture of margarine and salad oils.

A leading obstacle to increased distribution of raw peanuts has been that the public has had little opportunity of purchasing them in any but small quantities. It is, therefore, suggested that the nuts should be offered on the market in packages of one or two pounds. Other matters dealt with include the importance of grading, descriptions

of the processes in use for cleaning and shelling the nuts and for the manufacture of peanut products, such as roasted nuts, salted nuts, peanut butter, candy, oil, cake, meal and flour. The use of peanuts as a feed for hogs, and the utilisation of the husks are also discussed. Various suggestions are made for the improvement of the industry, and statistical information is given relative to the acreage and production of ground-nuts in the United States and other leading producing countries. The imports and exports of nuts and oil to and from the United States are also recorded with countries of origin and destination.

Kurrajong.—Kurrajong seeds are derived from *Brachychiton populneum*, R. Br. (*Sterculia diversifolia*, G. Don), a tree from 20 to 60 feet high, which is found from Gippsland, Victoria, throughout the eastern half of Australia as far as the Gulf of Carpentaria in Northern Territory. A paper on the oil obtainable from these seeds by F. R. Morrison, of the Technological Museum, Sydney, has recently been published (*Journ. and Proc. Royal Soc., New South Wales*, 1926, **59**, 267).

The seeds are contained in fig-shaped pods. Each seed consists of a white kernel enclosed in a black shell, covered with a yellow "furry" coating. The average length of a seed is 9 mm. and the average weight 0·13 gram. On extraction with ether or light petroleum the seeds yielded from 25·0 to 26·7 per cent. of a reddish, moderately viscous oil, which consisted of the glycerides of palmitic, oleic and linolic acids, and about 1 per cent. of unsaponifiable matter containing phytosterol and a yellow colouring matter. Two samples of these seeds were examined and the resulting oils tested with the following results. The oil from a sample received in 1924 became semi-solid after the lapse of several days, and had the constants :—melting point, 30° C. ; specific gravity at 30/30° C., 0·9083 ; refractive index at 20° C., 1·4676 ; acid value, 65·0 ; saponification value, 198·0 ; iodine value (Wijs, 2 hours), 101·3 per cent. ; unsaponifiable matter, 1·1 per cent. The oil from another sample received in 1925 did not set to a semi-solid on standing for a few days, but after keeping for some time at 12 to 15° C. a white crystalline deposit separated. This oil gave the constants :—specific gravity at 15/15° C., 0·9203 ; refractive index at 20° C., 1·4709 ; acid value, 42·7 ; saponification value, 192·8 ; iodine value (Wijs, 2 hours), 107·6 per cent. ; unsaponifiable matter, 1·5 per cent.

Oil Palms.—The five chief lines on which work is being carried out in Nigeria by the Agricultural Department in

connection with the oil-palm and its products are: (*a*) small scale processes for the extraction of oil by native extractors; (*b*) the extraction of the kernels and their separation from the shell; (*c*) a factory process for the extraction of the oil from the pericarp; (*d*) the improvement of the palmeries, and (*e*) the study of the varieties of palms (*Ann. Rep. Agric. Dept. Nigeria*, 1925, p. 10).

The object of the work on small scale extraction is to find a method of extraction which will be an improvement on the ordinary village processes, but which will not involve the use of any but the simplest apparatus. With this end in view two distinct processes have been evolved, namely, the "modified native" process and the "cooker and press" process. Both of them have been thoroughly tested and demonstrated at Loburo in the Abeokuta province. The former process does not involve the use of any imported apparatus. According to this method the fruits are steamed in a simple form of steamer and are then submitted to a treatment almost identical with that used in the "hard" oil process (see this BULLETIN, 1924, **22**, 214). The tests indicated that, although this process is a slight improvement on the old native processes, its comparative advantages are altogether too small to permit any real hope of its general adoption in the villages. Further work with this type of extractor is not to be undertaken.

The apparatus required for the "cooker and press" process consists of a simple cooker costing £15 in England, and a hand-press costing £25. In the former the fruits are heated for one hour under a pressure of a few ounces of steam. The heated fruits are then rubbed in a mortar and the pericarp separated by hand, the freed pericarp being pressed in the hand-press. By this method 60 to 65 per cent. of the oil can be removed from the pericarp in comparison with 45 to 50 per cent. by the native processes. The quality of the oil is good, there being no difficulty in obtaining oil containing as little as 5 per cent. of free fatty acids. It is felt, however, that the cost of the apparatus may be so great as to outweigh the advantages. Tests have shown that the process is successful in that it effects a marked improvement in the quality and quantity of the oil extracted, and that the total labour required is at least not substantially increased. The natives appreciated the labour-saving advantages of the cooker, but considered the pressing to be too hard work. There is reason to hope that conditions in the Eastern Provinces will prove more favourable to this innovation than in Oyo or Abeokuta, and demonstrations

will accordingly be carried out there. It is not considered that confidence in the eventual general adoption of this apparatus is yet justified, and efforts are being made to arrange for extended trials.

Various hand nut-cracking machines on the market have been tested, in the hope of finding one which is suitable for general recommendation, but so far none is considered sufficiently satisfactory for this purpose. It is doubtful whether hand-operated machines will ever be taken up. There is a better prospect for machines driven by low-powered oil-engines. The use of a mud bath has been found to be as satisfactory as that of a brine bath for separating the kernels from the shell.

As the suggestion of the formation of an Association, similar to the British Cotton Growing Association, to establish pioneer factories is meeting with little response, the Government is now considering other means of attracting commercial enterprise in this direction.

Meanwhile attempts have been made to improve the factory processes, and the use of the centrifuge for purifying the oil has given good results in continuous routine use.

In connection with the improvement of the palmeries it is stated that observations have shown that a palm grown from the beginning under plantation conditions, i.e. on cleared and weeded ground, bears much earlier, and gives a much higher yield in its early years than a " wild " palm ; and that a " wild " palm which has once been stunted by the competition of other plants in its early years never recovers under cultivation. The real problem in the improvement of the cultivation of the oil-palm in Nigeria is therefore to induce the farmers to cultivate it continually during the early years, especially the first seven or ten years, of its growth.

The results of the plantings of oil-palms of various varieties, chiefly at Calabar, have shown that none of them breeds true. Varieties will thus only be fixed through self-fertilisation and selection on Mendelian lines. As this process takes at least three generations and each generation of the oil-palm means about seven years, it will be a long time before varieties that will breed true can be fixed. In the meanwhile, however, records of the yield of fruit of individual trees in the fields of planted palms at Calabar have been maintained since 1922, and these with the results of the chemical examination of the fruit will yield reliable information as to which is the most profitable variety, and will also enable superior parent trees to be selected for breeding. In addition, progeny rows from individual parent trees at Calabar have been planted at

Benin and Umuahia, which, when they come into bearing, will indicate more reliably the best individual trees to use as parents

The cultivation of the oil-palm in Sumatra is discussed by Yves Henry in a recent number of *Bull. Econ. Indo-Chine* (1926, **29**, 1) in connection with its proposed cultivation in Indo-China. After describing the nature of the soil and the rainfall in Sumatra, the annual yields per hectare of fruits, oil and kernels are quoted from Dr. A. A. L. Rutgers's Monograph on "Investigations on Oil Palms" (see this BULLETIN, 1922, **20**, 491). It is pointed out, however, that in practice such yields apparently are not obtained. In support of this contention actual figures are shown for nine plantations. Attention is drawn to the fact that in many cases a heavy yield from a palm that has been artificially pollinated is followed the next year by a much smaller yield. It is considered that the oil-palm can only maintain an average yield in Sumatra by the regular application of manures. Clean weeding between the rows, whereby the humus is gradually decreased, has a tendency to lower the yield of fruits. Similar effects are produced, owing to the shallowness of the sub-soil, below which is a stratum of impermeable clay which the roots of the palm are unable to penetrate. As regards intercalary crops the use of lalang grass is strongly deprecated while the growing of *Calopogonium mucunoides* is recommended. The spacing of the palms so that 143 palms are planted per hectare is criticised, and it is considered that an arrangement giving 123 palms to the hectare would be more satisfactory. Further sections are devoted to a discussion of the influence of the time of the rains on the production, and to a consideration of selection of the variety to cultivate and also of artificial pollination.

In conclusion the author states that he is of opinion that an oil-palm plantation in Sumatra which gives an average yield is a sound investment.

A reprint from No. 12 of *Boletim da Agencia Geral das Colonias*, entitled "Subsidios para o estudo das palmeiras do azeite da regiao de Cazengo," has been published by Fomento Geral de Angola. This pamphlet deals with the oil-palm in the Cazengo district of Angola, and fourteen varieties are described which occur in this district. An account is given of the trees, fruits, nuts and kernels of these varieties, and of the composition of the fruits and kernels. The pamphlet is illustrated with a number of text-figures.

Essential Oils

Bay Oil.—A pamphlet dealing with the bay oil industry of the West Indies has been issued by A. E. Collens, Government Chemist and Superintendent of Agriculture for the Leeward Islands, and F. H. S. Warneford, Assistant Government Chemist. The bay tree, *Pimenta acris*, grows in most of the islands from Trinidad to Jamaica. It has been under systematic cultivation in Montserrat since 1903, and recently the industry has been inaugurated in St. Lucia and revived in Dominica. A useful account of the cultivation of the bay tree is given. The tree has been found growing at elevations from sea level up to 1,500 ft., and sometimes in situations unsuited to other crops. The best results are obtained in sheltered positions where there is a good supply of moisture. The tree is propagated from seed, and the seedlings are kept in the nursery for about a year before being transplanted into the fields. It is desirable to keep the trees in bush form to facilitate harvesting, which should be confined to shoots bearing mature leaves, as these give an oil in greater yield and of higher phenol content than the younger leaves. Experiments carried out in Montserrat showed that bays planted in 1908 gave a yield of 1,368 lb. of green leaves, and 14 lb. of oil per acre in 1911 when first harvested. The annual yield of leaves and oil continued to increase up to 1921, when the amount of green leaves and oil per acre was 10,075 lb. and 119 lb. respectively. During the next two years, though the harvest of leaves increased, the yield of oil somewhat diminished, and in 1924 a marked falling off was shown in both respects. Details are given of the methods of distilling bay leaves, and the types of stills employed. A higher yield of oil is obtained by the use of live steam than by simply boiling the leaves with water. The condensers, which should be made of block tin or copper, as iron soon corrodes in contact with the oil and discolours it, are connected with the stills by a side tube. No still-head is used as this tends to keep back the phenols by its fractionating effect. In Montserrat, where experimental distillations have been carried out for several years, the yield of oil from green leaves varied from 1·06 to 1·3 per cent. Marketable bay oil should contain not less than 40 to 50 per cent. of phenols.

Eucalyptus Oil.—With a view to stimulating the demand for the oil of *Eucalyptus phellandra*, a small pamphlet by A. R. Penfold has been issued as *Bull. No.* 11, *Tech. Educ. Branch, Tech. Museum, Sydney*, entitled "Some Industrial Uses of the Oil of Eucalyptus Phellandra."

For many years past large quantities of this oil have been distilled and sold, but the demand appears to have recently declined, probably owing to the slump in mining activities and the use of cheaper flotation agents. The author states that the oil has found extensive use in Australia for the manufacture of disinfectants, insecticides and boot polishes, and for perfuming cheap soap. In order to encourage the use of the oil for such purposes, formulæ are given for the preparation with it of disinfectants, paint removers, and insecticides.

Boronia citriodora.—A. R. Penfold has investigated the oil from *Boronia citriodora*, a Tasmanian alpine plant, which is especially plentiful in the neighbourhood of Cradle Mountain (*Journ. and Proc. Roy. Soc., New South Wales*, 1925, **59**, 35). The green leaves of this plant furnished from 0·71 to 0·93 per cent. of oil, which contained 80 per cent. of citronellol, mostly in the free state. The remainder of the oil appeared to consist mainly of terpenes and sesquiterpenes. *d*-α-Pinene was identified, and also a paraffin hydrocarbon of m.p. 64 to 65° C. Neither geraniol, citronellal nor citral could be detected in the oil.

FIBRES

Cotton

Nigeria.—An interesting account of the results of recent experimental work on cotton has been given in the *Ann. Rep. Agric. Dept., Nigeria, for the year* 1925.

The investigations which have been carried out in the Southern Provinces during the three years 1923 to 1925 have led to the following conclusions. The chief losses in the cotton fields have been caused by the internal boll rots conveyed by stainers, and the next most serious losses have been due to the attack of boll-worms. The bolls of American cotton are much more liable to shedding and damage as the result of the attacks of stainers than are those of the indigenous cottons, and the American cottons also appear to suffer rather more from boll-worm attack than the native kind. Of the native cottons, the bolls of the Ishan and Meko cottons show no great difference in the extent to which they are liable to be shed or damaged by the attacks of insects of either class, but the advantage on the whole seems to lie with the Ishan cotton. The indigenous cottons are rather more liable than the American types to diseases which are not carried by insects, but the Ishan cotton seems more resistant to these than the Meko

kind. With regard to yield most of the experiments show that the native cottons are superior to American.

It is not considered either immediately possible or even desirable that the practice of growing cotton in mixed cultivation with other crops, especially yams, should be discontinued. Experiments have shown that in admixture with yams the native cottons give much greater yields than the American varieties.

These facts indicate that for success in cotton-growing in the Southern Provinces it is desirable to evolve a strain of indigenous cotton of high quality and value. Of the two indigenous cottons the Ishan appears much more promising than the Meko kind. Strains of Ishan cotton have been isolated and bred which will be of high value for export if they can be grown on a large scale without deterioration. These strains have long white lint ; some of them produce very strong fibre, and give a high ginning yield. The growth of one of these strains would effect a great change in the cotton-growing industry, and create a real prospect of an extension of cotton production for export. The Ishan selections are now being multiplied as much as possible on the Moor Plantation.

In the Northern Provinces, the production of American cotton continues to increase. In the following table the exports of cotton and the price paid to the growers are shown for the years 1915–16 to 1925–26.

Exports of American Cotton from the Northern Provinces

Year.	No. of Bales.	Price per lb. for seed-cotton of 1st grade.	Year.	No. of Bales.	Price per lb. for seed-cotton of 1st grade.
		Pence.			*Pence.*
1915–16 .	121	1¾	1921–22	9,483	2
1916–17 .	433	1¾	1922–23	10,774	2⅛
1917–18 .	855	2⅛	1923–24	15,033	4 falling to 3
1918–19 .	2,248	2¾	1924–25	26,692	3
1919–20 .	3,568	3¾	1925–26	37,500	2⅛
1920–21 .	5,405	4⅛		(Estimated)	

It will be seen from these figures that although there was a fall in price, the exports in 1925–26 were about 40 per cent. greater than in 1924–25. In spite of the lower price in 1925–26 there was more competition in buying.

Motor transport is now cheaper than animal transport for distances of 30 or 40 miles. It has been used for conveying seed for distribution to growers in Funtua and Northern Katsina. This has been done at the expense of the Government, instead of its being carried as in the past by the firms themselves under the orders of the Native Administrations or else carried at the expense of the Native

Administrations. New ginneries are being erected at Funtua and Karadowa which will remove the necessity for transporting much seed in future to these particular areas.

Pink Boll-worm in Australia.—In 1923, Mr. G. Evans, of the Empire Cotton Growing Corporation, recorded the presence of the pink boll-worm (*Platyedra gossypiella*) on cotton plants growing at Broome in Western Australia, and later in the same year he observed it on wild cotton in the Roper River region, Northern Territory.

In April 1924, it was announced in the Brisbane press that the pink boll-worm had been discovered attacking cotton in Queensland. It has now been found that this insect is not *P. gossypiella*, but a distinct species, to which the name *Platyedra scutigera* has been given. An interesting account of this insect, including a description of the larval and pupal stages and notes on its life-history, has been given by F. G. Holdaway, M.Sc., in the *Bull. Entom. Res.* of July 1926 (vol. xvii, part 1, p. 67). Reference is also made to two other species of Platyedra occurring in Queensland.

The distribution of *Platyedra scutigera* is confined to the coastal areas of Queensland and the pest has not at present been found further than 100 miles from the sea. Wherever cotton has been grown on the coast, it has been heavily infested ; but no cotton has yet been attacked in South Queensland, apparently owing to the fact that the crop has not been grown near the sea. In order to explain these facts it is suggested that prior to the recent revival of cotton-growing in Queensland, the insect was feeding on *Hibiscus tiliaceus* and *Thespesia populnea*, and that, in the coastal districts, when cotton was planted it was attracted to the cotton, this being the primary cause of its extension inland.

The two other species of Platyedra which have been found in Queensland are referred to as *Platyedra* sp. (scarlet larva) and *Platyedra* sp. (Yamala larva). These do not appear to attack cotton, but feed on native species of Hibiscus and Abutilon.

Sisal Hemp

Dutch East Indies.—The cultivation of sisal hemp is undergoing rapid development in Sumatra. According to *Commerce Reports* (1926, No. 35, 534) the exports have steadily increased from 718 metric tons in 1920 to 16,213 tons in 1924 and 19,320 tons in 1925 ; a still larger output is expected during 1926. The greater part of the fibre is consigned to the United States, but during 1925 increased

quantities went to Germany and Holland. The whole of the sisal hemp so far produced in Sumatra has been in the hands of one large company, but an estate owned by another company was expected to be ready for cutting towards the close of 1926.

Mauritius Hemp

Reference to the Mauritius hemp or "aloe" fibre industry is made in the *Ann. Rep. Dept. Agric., Mauritius, for* 1925. The exports during that year amounted to 8,633 bales, each weighing 250 kilos. The Committee appointed by Sir Hesketh Bell, K.C.M.G., to consider methods for improving the fibre industry have presented their report, which recommends (1) the organisation of the growers to form an association which would co-operate in the handling, grading and marketing of the crop, and (2) the establishment of standard grades of Mauritius hemp. In accordance with these recommendations an Association has been formed, and efforts have been made to establish standard grades.

The Association applied to the Government for assistance towards the erection of a central grading and baling factory, and an advance of Rs. 100,000 was accordingly made, subject to certain conditions. The Director of Agriculture, when in England, arranged with buyers for the establishment of certain definite grades, and if these are accepted by the local producers, the industry will have been standardised to the mutual advantage of grower and purchaser.

RESINS

Lac.—Continuing his work in connection with lac insects (see this BULLETIN, 1926, **24**, 490), S. Mahdihassan has recently published two more papers on this subject. The first appeared in *Journal of the Science Association, Maharajah's College, Vizianagaram* (1925, **2**, Nos. 2 and 3, pp. 64–88) and is entitled "Some Insects associated with Lac and a Symbolic Representation of their Inter-relationship."

In this the author describes in some detail the parasites (internal and external) of the lac insect, and the hyperparasites accompanying them.

Attempts to increase the hyperparasites without simultaneously adding greatly to the number of harmful insects failed completely. The presence of a large number of hyperparasites frequently results not only in the death of the parasites themselves, but also in the destruction

of the whole lac colony, whereas the absence of hyperparasites often occurs when few parasites are present and large numbers of lac insects remain unattacked.

"The internal factors regulating the activity of the lac insect seem to be two, and very distinct and potent ones, (1) predisposition or attraction to enemies, (2) sex ratio variability."

The parasites increase in numbers in circumstances in which the mothers give rise to a progeny highly favourable to the male. One such circumstance is excessive moisture.

The inter-relationship of the different organisms associated with a lac colony is shown in diagrammatic form at the end of the paper. This diagram includes the tree harbouring the lac insect and the insect itself, together with the various parasites, hyperparasites, bacteria, etc., which may be considered directly or indirectly to affect the colony as a whole.

In his second paper, "The Main Crop of Lac and the Best Season for its Inoculation" (*loc. cit.*, 1926, **2**, No. 4, pp. 91–113), the author first gives a brief account of existing information on the subject, which is collected in a table showing locality, host-plant, season of main crop, and time when the brood lac is left uncut for self-propagation. From this it is deduced that less succulent, hard-wooded plants furnish larger lac crops at the end of the monsoon, and more succulent host-plants behave in the same way as the less succulent in dry localities, but in moist positions yield larger non-monsoon lac crops. A number of the various host-plants are then dealt with individually, under the two broad divisions, non-succulent and succulent. In the summary at the end of the paper it is stated that "loss of larvæ during swarming and mortality during larval stages reduce the population of lac colony and affect both brood lac and lac crop. Mortality later in life makes brood lac scarce, but has little effect on the quantity of lac crop."

Mortality is associated more with drought than with excessive rains or extremes of temperature. "Brood lac is scarcer early in the rainy season even when the lac crop is larger. Moisture increases size of the insect and encrustation, drought favours secretion layer." "Value of brood lac depends upon (1) better survival ratio or ratio of living ones to the dead, (2) sex ratio in the issuing generation favourable to the female."

Thus the former decides the amount, and the latter the quality of the brood lac. "In all cases the sex-ratio is better and survival ratio less in the non-monsoon brood lac

than in the other ; the choice lies as to which is the greater limiting factor." Since the chief consideration is the choice of a season during which mortality among the inoculated insects is low, the introduction of lac early in the monsoon season is recommended.

Tanning Materials and Leather

Nigerian Leather.—In connection with the production of "morocco" leather within the Empire, brought into prominence some time ago by a question raised in Parliament, interest attaches to a description given by Dalziel in *Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew* (No. 6, 1926, p. 225), of the dyeing of leather in Nigeria.

Accounts of the manufacture of the native leather of West Africa have already been given in this Bulletin (1908, **6**, 175 ; 1910, **8**, 402), and additional information on the dyeing of the leather is furnished by Dalziel. The mineral and vegetable colouring matters usually employed are as follows : for red leather, a red variety of *Sorghum guineense ;* yellow, chiefly *Cryptolepis sanguinolenta, Curcuma longa* (turmeric), or *Anogeissus Schimperi* ; green, copper or brass filings with a mineral salt ; black, iron (in the form of blacksmith's slag) in conjunction with a vegetable tanning material ; blue, almost entirely by means of plants yielding indigo, viz. *Lonchocarpus cyanescens,* and species of *Indigofera.* Imported aniline dyes are also frequently used in the production of these coloured leathers. For the majority of leathers, goat skins are employed, and the application of the dye is made to the grain side of the skin, after it has been tanned. For green leather, however, sheep skins are used, and the dye is applied to the flesh side of the untanned skin.

Various European and American firms are attempting to educate the native leather workers in up-to-date methods, with a view to removing the defects in Nigerian goat skins in order that the latter may compete with European "morocco" leather.

"Gonyo."—An article entitled, "Une Anacardiacée tannifère nouvelle du Congo belge, Le Gonyo," has been contributed by J. Pieraerts to *L'Agronomie Coloniale* (1926, **14**, No. 100, 162). "Gonyo" is a tree growing to a height of 15 to 20 metres, which is found here and there in Mayombe, chiefly in the Temvo region and the neighbourhood of Ganda-Sundi. It is stated to be a new species of the N.O. Anacardiaceæ to which de Wildeman has given the name *Antrocaryon Nannani.*

The appearance of the tree is described, and tables are given showing how infusions of various parts (bark, wood and leaves) behave towards chemical reagents and recording their quantitative analysis as tanning materials. The results show that the bark of the trunk and larger branches contains about 9 per cent. of a mixed tannin and very little soluble non-tannins, and that the leaves contain about 30 per cent. of a pyrogallol tannin. The infusions of the former are reddish-brown in colour, those of the latter greenish-yellow. It is considered that "Gonyo" deserves attention as a source of concentrated tanning extracts.

Black Cypress.—The results of investigations carried out by Coombs, McGlynn and Welch on the tannins of the black cypress pine are published in *Journ. and Proc. Roy. Soc., New South Wales* (1925, **59**, 356).

The black cypress pine (*Callitris calcarata*, R.Br.) is an important tannin-bearing tree which occurs in large quantities over a very wide area of the inland portions of the Eastern States of Australia and, in a few localities, extends even as far as the coast.

The structure of the bark and the extraction of the tannins from it (which occur to the extent of 18 to 36 per cent.) are described. The tannin in the inner living bark is readily soluble in water, but it becomes progressively less soluble in the outer portion, and finally becomes practically insoluble at the outside.

A high temperature is necessary for the efficient extraction of the tannin from the bark, and experiments carried out on a practical scale showed that a considerable amount of tannin is destroyed in the process. This is not considered to be due to the temperature employed since the bark is not sensitive to high temperatures, but to the starch present, which is shown to be capable of destroying considerable quantities of tannin. For satisfactory commercial extraction the bark should be finely ground on account of its resistance to penetration by water.

Analyses of different layers of the bark showed that the maximum tannin content occurs towards the outside of the inner zone, the soluble non-tannins reaching a maximum on the inside of this zone. It is also shown that small, well-grown trees are the richest in tannin, and that the pine bark differs from wattle bark in that there is little or no variation in the tannin content of the bark removed from different heights on the tree.

Commercially the bark should yield about 20 to 25 per cent. of tannin.

Mangroves of Indo-China.—An article by F. Heim de Balsac and others on the mangroves of Indo-China has recently appeared in *Bull. de l'Agence Gén. des Colonies* (1926, **19**, 714–738, 873–909).

The author and his collaborators have already published the results of investigations carried out on the mangrove tanning barks of Madagascar (*Bull. Ag. Gén. Col.*, 1923, 712–726) and Indo-China (*J. Soc. Leather Trades Chem.*, 1924, **8**, 355–358), but the latter article described only one kind of mangrove, whilst the present one deals with a comparatively large number.

The paper is divided into three parts. The first treats of mangroves in general. The trade in mangrove bark and extract is reviewed, and it is shown that the exportation of the bark has fallen off since the war, chiefly owing to the abstention of Germany, which before the war imported several tens of thousands of tons annually from Madagascar against 750 tons in 1922 and 1,276 tons in 1923.

The trade in extract, however, has improved, and whereas the Dutch East Indies exported only 805 tons of solid extract in 1918, in 1919 3,550 tons were exported, chiefly to Japan. The United States imported 2,220 tons of the extract ("mangrove cutch") in 1919. But these figures shrink into insignificance in comparison with those for solid quebracho extract (total production in 1923, 160,000 tons) and solid mimosa extract (15,000 tons exported from Natal in 1923). Thus mangrove holds but a small place in the world's markets, in spite of the enormous quantities available. Mangroves form the principal part of the forests on the coasts and low-lying parts of tropical and sub-tropical regions of the world. For instance, in Madagascar alone, the trees occupy 400,000 hectares, and in the Philippines 200,000 hectares.

The author enumerates the various botanical species usually considered as mangroves, and describes their modes of reproduction. He also deals with the collection of the bark (rendered somewhat difficult by the semi-aquatic situation of the trees), its tanning properties, and the rather objectionable dark red colour usually imparted to skins by unbleached extracts.

The second part of the article is concerned exclusively with the mangroves of Indo-China, which include *Rhizophora capsularis* (?), *R. Mangle* (?), *R. cochinchinensis* (?), *R. conjugata*, and *R. mucronata*, *Bruguiera gymnorrhiza* and *Ceriops* sp. These are fully described, their native names are given, and information is supplied on the composition of the barks, the nature of the tannin present, and the

quality of the leather produced. The tannin content varies between 23·9 per cent. for a sample of *R. cochinchinensis* (?), and 10·0 per cent. for one of *R. mucronata.* The commercial possibilities of each variety of bark are also dealt with, and it is stated that in no case is the tannin content sufficiently high to warrant exportation of the bark itself, but, with the exception of *Ceriops* sp. and *Rhizophora mucronata*, it should be possible to manufacture tanning extracts for export.

In the last part of the article comparative tables are given showing countries of origin, local names, and general analytical and technical properties of the mangroves of the world, including species of *Rhizophora*, *Bruguiera*, *Ceriops* and *Kandelia*.

It is observed from these that only in Madagascar and East Africa have the mangroves sufficient tannin to allow of the exportation of the bark.

Malayan and Australian mangroves are fairly rich in tannin, but do not contain so much as those of Madagascar and East Africa, whilst the barks of mangroves from India and Indo-China possess less still.

The species which generally contain the most tannin are *Rhizophora* spp., *Bruguiera gymnorrhiza*, *B. eriopetala*, *Ceriops Candolleana*, *C. Tagal*, and *Kandelia Rheedii*. The average tannin content is between 20 and 40 per cent.

FORESTRY AND TIMBERS

Cyprus Forests.—A useful "Short Description of the Forests of Cyprus," by Dr. A. H Unwin, Principal Forest Officer, has been published by the Cyprus Government. Formerly Cyprus was very heavily wooded, but at the present time the forest area comprises only 415,000 acres, of which over 96 per cent. is state-owned. In the northern range the chief types of forest comprise pure and mixed high forests of Aleppo pine (*Pinus halepensis*) and cypress (*Cupressus sempervirens*), together with mixed stands of olive, *Arbutus Andrachne*, oak (*Quercus coccifera*) and Juniper (*Juniperus phœnicia*). The forests of the southern mountains include pure high forests of Aleppo pine and Corsican pine (*Pinus nigra* var. *pallasiana*), cedar (*Cedrus libanotica* var. *brevifolia*), forests of dwarf oak (*Quercus alnifolia*), mixed plane and alder forests (*Platanus orientalis* and *Alnus orientalis*), and an orchard type consisting mainly of carob (*Ceratonia siliqua*) or olive. It is estimated that the annual increment of timber is about 3,250,000 cubic feet, from which must be deducted some 2,000,000 cubic feet resulting from losses due to fire, insect attack and decay,

and grazing. Practically the whole of the timber cut is felled and converted under government supervision, and the manufactured timber is sold direct to the public by the Forest Department; in addition some 5,000 acres of wattle (Acacia) yield fuel in increasing quantities. The annual revenue of the department averages £24,000 and the expenditure £36,000. There is a promising local movement in favour of afforestation, and the demand for seedlings at present exceeds the supply. In the existing forests, natural regeneration, especially of Aleppo pine, is satisfactory, while in the new plantations the introduced species most successful are stone pine (*Pinus Pinea*), walnut (*Juglans regia*), tree of heaven (*Ailanthus glandulosus*), *Eucalyptus resinifera* and *Acacia cyanophylla.*

Australian Timbers.—In a paper read before the Royal Society of New South Wales (*Journ. and Proc. Roy. Soc., New South Wales*, 1925, **59**, 276), M. B. Welch records the results of a study of the macroscopical and microscopical characters of a number of Australian timbers belonging to the natural family Saxifragaceæ. In the Eastern States of Australia, particularly in New South Wales and Queensland, several genera of this family produce timber trees of large size, the following being of commercial interest: Quintinia, Polyosma, Callicoma, Ceratopetalum, Schizomeria, Ackama, Weinmannia and Geissois. Of these the most important species is *Ceratopetalum apetalum*, D. Don, or Coachwood, well known for its toughness and strength and valued for furniture and cabinet-making, motor-body work, carriage-building, brush-backs, etc. The paper includes a key to the identification of the timbers described and photographs of transverse microscopical sections.

The author, in a further paper presented to the same Society (*loc. cit.*, 1925, **59**, 329), gives a key, based on microscopical characters, to the identification of the principal ironbarks and certain timbers (grey gums, *Eucalyptus punctata*, D.C. and *E. propinqua*, Deane and Maiden) frequently confused with them. The ironbarks considered are white or grey ironbark (*E. paniculata*, Sm.), narrow-leaved ironbark (*E. crebra*, F.v.M.), broad-leaved ironbark (*E. siderophloia*, Benth.) and red-flowering ironbark (*E. sideroxylon*, A.Cunn.). Excellent photomicrographs accompany the paper.

British Honduras Timbers.—In *Tropical Woods* (1926, No. 7) G. W. E. Francis, Superintendent, British Honduras Railway, gives an account of the use of native woods of the Colony for railway sleepers. During the construction

of the Government Railway in Stann Creek, British Honduras, sixteen years ago, use was made of creosoted Norwegian pine (*Pinus sylvestris*) sleepers. In 1914 these were replaced in the older sections of the line by sleepers of native woods and since then no sleepers have been imported. Eight principal timbers have been under trial, and sleepers measuring 7 ft. × 7½ to 8 in. × 6 in. were cut from young poles and air-dried under shelters for periods up to four months. A brush treatment of preservative has been tried in several cases, but owing to weather conditions the treatment adds only about a year to the life of the sleeper. Woods with lower initial water-content last in the hinterland 3½ to 4 years without treatment, while nearer to the coast, where the humidity is less, untreated wood lasts 4½ or 5 years. It is thought that better results would be obtained if the sleepers were sawn from larger trees containing a greater proportion of heartwood. The timbers, arranged in two classes according to their durability, are as follows: First class: Santa Maria (*Calophyllum Calaba*, Jacq.), Nargusta (*Terminalia obovata* (R. et P.) Eichl., Salmwood (*Cordia Gerascanthus*, L.), Ridge Redwood (*Mosquitoxylum jamaicense*, K. et U.), Yemeri heartwood (*Vochysia hondurensis*, Sprague) and Waika Chewstick (*Symphonia globulifera*, L.f.). Second class: My Lady (*Aspidosperma megalocarpon*, Muell.) and Bullhoof (? *Drypetes* sp.).

Teak.—An interesting comparison of the methods of teak exploitation adopted in the British and Dutch East Indies is contributed by A. J. Warta to *Tectona* (Deel xix, Afl. 6, 1926). An important point of difference lies in the fact that while selection-felling is adopted in Burma the Dutch practise the clean-felling method. Characteristically, the British exploitation is mainly carried out by private enterprise. The Dutch exploitation, however, is chiefly in the hands of the Government, who, it is stated, classify the timber brought on to the market in over a thousand assortments as against a score or so grades adopted in the British trade. It is further remarked that the Dutch practice is to work up the logs in the forest to hewn round logs and to squares of different sizes, while in British India the logs in the rough are sent to the saw mills to be worked up to merchantable sizes. [It may be remarked, however, that teak from India is imported into this country as squared logs, planks and scantlings.] Reference is made to the action taken a short time ago by a London firm of timber merchants in importing teak in round logs.

Mahogany in Java.—An illustrated monograph on mahogany (*Swietenia Mahagoni*, Jacq. and *S. macrophylla*, King) with special reference to the cultivation of the trees in the Netherlands East Indies is published as No. 15 (1926) of the *Mededeelingen van het Proefstation voor het Boschwezen* by A. C. Noltée under the title of the names of the two species mentioned. The small-leaved mahogany (*S. Mahagoni*) was first introduced into Java in 1870 and seed was also obtained by the Forest Service in 1879; *Swietenia macrophylla* was introduced in 1888. Seeds of trees grown in Java were collected for the first time in 1892, and from that date (and especially between the years 1897 and 1902) the cultivation of mahogany has been rapidly spreading over Java. At the present time the largest plantations are in the forest districts of Semarang and Pekalongan-Kendal (Petjalongan) and in Margasari. Most of the planted areas are in the plains, but the trees are grown up to an altitude of about 1,000 metres and are frequently planted on private estates and as roadside trees in many of the towns. From Java the cultivation has been carried to Celebes and Sumatra. The monograph contains a botanical description of the two species and a detailed account of their sylviculture. So far the cultivation has been a success and of the comparatively few failures met with the majority have been due to the depredations of the "mahogany shoot-borer" (*Hypsipyla robusta*, Moore) which is a dangerous pest in young plantations. The timbers of the two species are very similar, and exhibit small differences only. The wood has been found to be useful for all ordinary construction purposes, where great strength is not necessary, and where the wood is not in contact with the soil. The Javanese wood is said to resemble the light "bay" mahoganies obtained from Central America.

The above publication contains a short account of the pests and diseases of the trees, but this aspect of the subject is fully dealt with by L. G. E. Kalshoven in No. 99 (1926) of the *Mededeelingen van het Instituut voor Plantenziekten*, which aims at affording the most recent information on the subject for the use of forest officers in Java. Special attention is given to an account of the present position of the investigations on the shoot-borer, which is the most important insect pest, and to the shot-hole borer of twigs and seedlings (*Xyleborus morigerus*, Bldf. and *X. morstatti*, Hag.) and the attacks of squirrels, which latter are to be reckoned among the major enemies of mahogany trees in Java. The shoot-borer is the larva of a large moth. The eggs are laid on the youngest parts of the

shoots, and the young caterpillars enter the top of the shoot in which they excavate a longitudinal tunnel from the top downwards. Young tender shoots are wholly destroyed, but in older twigs the tops only are killed : the effect upon the growth of the young trees will be obvious. The principal native food plant of Hypsipyla is *Toona* (= *Cedrela*) *sureni*. Both mahogany species are attacked, but *Swietenia macrophylla* stands the loss of the shoots much better than *S. Mahagoni*. Control or preventive measures have not yet been fully worked out, but the author is of opinion that mahogany grown in mixed planta-tions with faster growing species suffers less from the attacks of this pest. Fungus diseases have not yet proved serious. Branches and saplings are sometimes killed by *Corticium salmonicolor*, and the brown root fungus (*Fomes lamaoensis*) has been observed in experimental plantings. A key for the identification of the various pests, diseases and causes of injuries to the trees is a feature of the paper and should prove most useful to forestry officers.

Forestry in Netherlands Indies.—An investigation into the various problems of forest regeneration in relation to timber felling, that has been carried out in the Preanger district of Java, is dealt with in a publication entitled "Onderzoek naar de natuurlijke verjonging en den uitkap in Preanger gebergtebosch," which is issued by the Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië as *Mededeelingen van het Proefstation voor het Boschwezen*, No. 14 (1926). An early chapter gives a résumé of information relating to forest regeneration in various countries, including Switzerland, Germany, France, Austria, Scandinavia and Finland, Holland and India, as well as the Netherlands Indies. This is followed by an account of the climate, soil and plant ecology of the district in which the investigation was carried out, after which details of the investigation are given and its results discussed. There is an extensive bibliography of publications consulted, the majority of which are in German or Dutch.

Timbers of Netherlands Indies.—The Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië has issued, as No. 12 of the series of *Korte Mededeelingen van het Proefstation voor het Boschwezen* (1926), a publication in English entitled "Mechanical Properties of Dutch East Indian Timbers." This is a revised edition of No. 1 of the same series. The mechanical properties of woods, as determined in the laboratory, are discussed in relation to their practical significance ; and in view of the

complexity of the tests employed an attempt is made to correlate the various mechanical properties with specific gravity, the object being to ascertain whether for practical purposes a rapid comparison between the properties of different woods may be made by simple density determinations. A considerable number of woods of the Netherlands Indies have been subjected to mechanical tests, and the results tabulated. It is claimed that the bending, crushing, shearing, and tangential cleavage strengths of the woods show a roughly proportional relationship to their specific gravities, whilst hardness as determined by Janka's steel ball method varies approximately as $\sqrt{g^3}$ where g is the specific gravity. The attempts of previous investigators to establish mathematical relationships between the different mechanical properties of timbers and their specific gravities are briefly reviewed. The results of a preliminary investigation of the mechanical properties of green woods in comparison with those of the same woods in the air-dry condition are also recorded; and finally there are tabulated some comparative tests with specimens of teak having annual rings of different widths, which indicate that teak wood of normal growth has a higher specific gravity and better mechanical properties than that having narrow rings showing slow growth.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the months of September and October 1926.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

Agriculture

General

Report of the Superintendent of Agriculture, Malta, for 1925–26. Pp. 16, 12½ × 9. (Malta Government Gazette Supplement, No. LVII, September 10, 1926.) Price 4*d.*

Administration Report of the Director of Agriculture, Ceylon, 1925. Pp 60, 13 × 8¼. (Colombo: Government Printer, 1926.) Price Rs.1.25.

Report of the Botanical and Forestry Department, Hong Kong, for the year 1925. Pp. 17, 9¾ × 6. (Hong Kong: Government Printers, 1926.)

Annual Report of the Department of Agriculture, Assam, for the year 1925–26. Pp. 33 + 4, 9¾ × 6½. (Shillong: Assam Government Press, 1926.) Price As.8 (1*s.*).

Season and Crop Report of Burma for the Year ending June 30, 1926. Pp. 55, 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1926.) Price R.1 (1*s.* 6*d.*).

Report of the Economic Botanist, Burma, Mandalay, for the Year ended June 30, 1925. Pp. 9, 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1926.) Price As.4 (5*d.*).

Annual Report on the Department of Agriculture, Straits Settlements and Federated Malay States, for the Year 1925. Pp. 12, 13 × 8¼. (Kuala Lumpur: Government Press, 1926.)

Annual Report on the Department of Agriculture, Mauritius, for the Year 1925. Pp. 26, 13 × 8¼. (Port Louis: Government Printer, 1926.)

Annual Report of the Department of Agriculture, Gambia, for the Year 1925. Pp. 52, 13 × 8¼. (London: Crown Agents for the Colonies, 1926.) Price 5*s.*

Annual Report of the Department of Agriculture, Kenya, for the Year ended December 31, 1925. Pp. 204, 9¾ × 6¼. (Nairobi: Kenya and Uganda Railway Press, 1926.)

Annual Report of the Department of Agriculture, Nyasaland, 1925. Pp. 28, 13 × 8¼. (Zomba: Government Printer, 1926.)

Annual Report of the Department of Agriculture, Uganda, for the Year ended December 31, 1925. Pp. 52, 13 × 8¼. (Entebbe: Government Printer, 1926.) Price 4*s.*

Annual Report on the Agricultural Department, Zanzibar, for the Year 1925. Pp. 22, 9½ × 6. (Zanzibar: Government Printer, 1926.)

Report on the Department of Agriculture, Barbados, 1925–26. Pp. 27, 13 × 8¼. (Barbados: Government Printer, 1926.)

Report of the Department of Agriculture, Bermuda, for the Year 1925. Pp. 78, 13 × 8¼. (Hamilton, Bermuda: Mid-Ocean Press, 1926.)

Report on the Department of Science and Agriculture, British Guiana, for the Year 1925. Pp. 65, 13 × 8¼. (Georgetown: Government Printer, 1926.)

Agricultural Statistics, British Columbia, 1925. *Bull. No.* 97, *Dept. Agric., Stat. Br.* Pp. 44, 10 × 6½. (Victoria, B.C.: Government Printer, 1926.)

Annual Report, Department of Agriculture, New Zealand, 1925–26. Pp. 36, 13 × 8¼. (Wellington: Government Printer, 1926.)

Besoekisch Proefstation voor Rubber, Koffie en Tabak. Verslag over het Jaar 1925. *Med. No.* 41. Pp. 58, 10¼ × 7½. (Ned. E. Indies, 1926.)

The Arrangement of Field Experiments. By R. A. Fisher. *Journ. Min. Agric.* (1926, **33**, 503–513).

Field Experimental Methods. Practice of the Fields Division in Canterbury. By A. W. Hudson. *New Zealand Journ. Agric.* (1926, **33**, 6–14).

Irrigation in India, Review for 1924–25. Public Works Branch, Department of Industries and Labour, India. Pp 37, 9¾ × 6¼. (Simla: Government of India Press, 1926.)

The Soil

Report on the Survey of the Soils of the Colony and Protectorate of Sierra Leone. By F. J. Martin. Pp. 13, 12½ × 8. (Freetown: Government Printing Office, 1926.)

Aluminium and Acid Soils. By J. Line. *Journ. Agric. Sci.* (1926, **16**, 335–364).

The Importance of Texture in Soils. Loose and Close Soils Compared. By B. C. Aston. *New Zealand Journ. Agric.* (1926, **33**, 1–5).

Decomposition of Organic Matter in Soil. By H. H. Hill. *Journ. Agric. Res.* (1926, **33**, 77–99.)

Wood Ashes as an Ameliorant of Soil Acidity. By S. K. Mitra. *Agric. Journ. India* (1926, **21**, 357–365).

The Purchase and Valuation of Fertilisers. By E. V. Flack. *Rhodesia Agric. Journ.* (1926, **23**, 740–750).

Influence of Manures and Micro-organisms on H-ion Concentration in the Soil. By E. Aghnides. *Intern. Rev. Sci. and Pract. Agric.* (1926, **4**, N.S., 294–306).

Insect and Animal Pests—General

Experiments with Certain Arsenates as Soil Insecticides. By B. R. Leach. *Journ. Agric. Res.* (1926, **33**, 1–8).

Insecticidal Value of Certain War Chemicals as Tested on the Tent Caterpillar. By F. J. Brinley. *Journ. Agric. Res.* (1926, **33**, 177–182).

The Chinch Bug and How to Fight it. By W. P. Flint and W. H. Larrimer. *Farmer's Bull. No.* 1498, *U.S. Dept. Agric.* Pp. 16, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

The Hibiscus Mealy Bug (*Phenacoccus hirsutus*, Green) in Egypt in 1925, with Notes on the Introduction of *Cryptolæmus montrouzieri*, Muls. By W. J. Hall. Pp. 15, 10¾ × 7½. (Cairo: Government Press, 1926.) Price P.T.5.

Effect of Temperature and Moisture on Nematode Root Knot. By G. H. Godfrey. *Journ. Agric. Res.* (1926, **33**, 223–254).

The Giant Snail (*Achatina fulica*, Fer.) in Malaya. By F. W. South. *Malayan Agric. Journ.* (1926, **14**, 231–241).

Foodstuffs—General

Nutrients Required for Growth Production with Indian Foodstuffs. By F. J. Warth and I. Ahmad. *Mem. Dept. Agric., India, Chem. Ser.* (1926, **8**, 211–233).

Analyses of Chinese Food Materials. By W. H. Adolph. *Philippine Journ. Sci.* (1926, **30**, 287–293).

Beverages

L'Origine géographique et botanique des Cacaoyers et l'utilité de leur greffage. By H. Pittier, A. Fucke and A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 344–349).

Die Philippinen als Kakaoland. *Gordian* (1926, **32**, 4380–4384).

Die Aufbereitung des Kakaos. By P. Preuss. *Tropenpflanzer* (1926, **29**, 343–350).

Preliminary Study of the Life-history and Habits of *Sahlbergella singularis*, Hagl. and *S. theobroma*, Dist. By G. S. Cotterell. Pp. 26, 9½ × 6¼. (Accra: Government Printer, 1926.)

The Coffee Industry of Kenya Colony. By A. D. le Poer Trench. *Bull. No.* 8, *Dept. Agric., Kenya.* Pp. 18, 9¾ × 6¼. (Nairobi: Government Press, 1926.)

The Coffee Industry of Costa Rica. By H. S. Waterman. *Spice Mill* (1926, **49**, 1214–1222).

The Coffee Industry in Nicaragua. By H. Playter. *Spice Mill* (1926, **49**, 1598–1601; 1808–1813).

La Culture du Caféier Excelsa à Java et en Indochine. By R. du Pasquier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 136–44).

La Question des Porte-Ombre dans les Plantations de Caféiers et de Cacaoyers. By H. Pittier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 65–69).

Algumas molestias cryptogamicas novas do systema radicular do caféeiro. By R. Averna-Saccá. *Public. No.* 17, *Commissão de Estudo*

e Debellação de Praga Cafèeira, Sec. Agric., Comm. e Obras Publicas. Pp. 12, 9 × 6½. (Sao Paulo, 1926.)

The Occurrence of Sclerotium Disease of Coffee in the North-Western District of British Guiana. By R. A. Altson. *Govt. Notice, No.* 16, 1926. (*Official Gazette*, July 17, 1926.)

Cut-back Tea. By H. R. Cooper. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1926, Part II, pp. 48–60).

Some Preliminary Notes on Tea Termites. By F. P. Jepson. *Trop. Agric., Ceylon* (1926, **67**, 67–79).

The Treatment of Root Diseases [of Tea]. By A. C. Tunstall. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1926, Part II, pp. 45–47).

Sclerotium bataticola, Taub. [on tea in Ceylon]. By W. Small. *Trop. Agric., Ceylon* (1926, **67**, 94–95).

Cereals

Sur la Maturité comparée des Céréales. By E. Miège. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 337–344, *cont.*).

The Effect of Outside Rows on the Yields of Plots of Kafir and Milo, at Hays, Kans. By J. S. Cole and A. L. Hallsted. *Journ. Agric. Res.* (1926, **32**, 991–1002).

Maize in Kenya. By E. Harrison. *Bull. No.* 7, *Dept. Agric., Kenya.* Pp. 9¾ × 6½. (Nairobi: Government Press, 1926.)

The Production of Maize in Southern Rhodesia. By C. Mainwaring. *Rhod. Agric. Journ.* (1926, **23**, 695–710).

Lower Burma Paddy and its Improvement. By D. Hendry. *Agric. Journ. India* (1926, **21**, 295–304).

La Culture du Riz dans le Milanais. By H. Lonay. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 1–12).

Aperçu sur l'État actuel de la Culture du Riz en Espagne. By N. Novelli. *Riz et Riziculture* (1926, **2**, 21–28).

Le Riz à Madagascar. (1) Sa Culture par les Indigènes. (2) Sa production en grande culture. Possibilités d'application des méthodes de la riziculture italienne. By J.-H. Leroy. *Agron. Col.* (1926, **15**, No. 104, pp. 41–49; No. 105, pp. 96–101, *cont.*).

Le Riz dans l'Alimentation des Animaux Domestiques. By Heim de Balsac and E. Letar. *Riz et Riziculture* (1926, **2**, 30–41; *cont.*).

Le Charançon du Riz (*Calandra Orizæ*, Linn.). By R. Lami. *Riz et Riziculture* (1926, **2**, 43–61).

The Quality of New Zealand Wheats and Flours. By L. D. Foster. *Trans. New Zeal. Inst.* (1926, **56**, 738–743).

Chemistry of New Zealand Wheats and Flours. I. The Degree of Buffering and Baking-Value of some Local Wheat-Flours. By L. D. Foster. *New Zealand Journ. Sci. and Technol.* (1926, **8**, 236–242).

A Physiological Study of the Growth of the Mediterranean Flour Moth (*Ephestia Kuehniella*, Zeller) in Wheat Flour. By C. H. Richardson. *Jour. Agric. Res.* (1926, **32**, 895–929).

Inheritance of Resistance to Leaf Rust, *Puccinia triticina*, Erikss., in Crosses of Common Wheat, *Triticum vulgare*, Vill. By E. B. Mains, C.E. Leighty and C. O. Johnston. *Journ. Agric. Res.* (1926, **32**, 931–972).

Inheritance of Resistance to Bunt, *Tilletia tritici* (Bjerk.) Winter, in Wheat. By F. N. Briggs. *Journ. Agric. Res.* (1926, **32**, 973–990).

Copper Carbonate prevents Bunt (Stinking Smut) of Wheat. By W. H. Tisdale. *Dept. Circ.* 394, *U.S. Dept. Agric.* Pp. 9, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Copper Powders for the Prevention of Ball Smut in Wheat. By G. L. Sutton. *Journ. Agric., W. Australia* (1926, **3**, 2nd. Ser., 246–253).

Sugar

Expériences avec la Canne à sucre dans les Petites Antilles et la Guyane anglaise. By H. Williams. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 219–228).

Report on Sugar-cane Experiments, Barbados, for the season between 1924–1926. By J. P. d'Albuquerque. Pp. 27, 13 × 8¼. (Barbados: Government Printer, 1926.)

Notes on the Froghopper Blight of Sugar-cane in Trinidad. By E. P. Mumford. *Bull. Entom. Res.* (1926, **17**, 139–150).

The Damage Caused by the Sugar Cane Moth Borer in Guadeloupe. By H. Williams. *Tech. Bull. No.* 4, *Sta. Agron., Guadeloupe.* Pp. 28, 9 × 6¼. (Pointe-à-Pitre: A. and J. Lautric, 1926.)

Diseases of Sugar Cane in Mauritius. By E. F. S. Shepherd. *Bulletin No.* 32, *Gen. Ser., Dept. Agric., Mauritius.* Pp. 18, 9¾ × 6. (Port Louis: Government Printer, 1926.)

Fermentation of Bagasse in Relation to the Yield of Industrial Alcohol. By W. L. Owen and N. Bennett. *Intern. Sug. Journ.* (1926, **28**, 463–469.)

Sugar Beet Experiments [in Ireland] 1925. *Journ. Dept. Lands and Agric., Ireland* (1926, **26**, 19–45).

Investigations into the Desiccation (De Vecchis) Process for producing Sugar from Sugar Beet. Progress Report. By B J. Owen. *Min. Agric. and Fisheries.* Pp. 20, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 4*d*.

The Effect of Moisture on the Loss of Sugar from Sugar Beets in Storage. By D. A. Pack. *Journ. Agric. Res.* (1926, **32**, 1143–1153).

Root Crops

Le Manioc à Madagascar. By C. Rollot. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 81–88; 152–159).

Investigations on the Leaf-roll and Mosaic Diseases of the Potato. By P. A. Murphy and R. McKay. *Journ. Dept. Lands and Agric., Ireland* (1926, **26**, 1–8).

The Comparative Susceptibility of Sweet-Potato Varieties to Black Rot. By L. L. Harter, J. L. Weimer and J. I. Lauritzen. *Journ. Agric. Res.* (1926, **32**, 1135–1142).

Influence of Soil Temperature and Soil Moisture on the Infection of Sweet Potatoes by the Black-Rot Fungus. By L. L. Harter and W. A. Whitney. *Journ. Agric. Res.* (1926, **32**, 1153–1160).

Fruits

Packing Deciduous Fruit for Export. By R. J. Bulmer. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 507–513).

Insects attacking Dried Fruits. By G. Quinn. *Journ. Agric., S. Australia* (1926, **30**, 116–118).

Tests to Determine the Presence of Arsenic in Apples after Treatment with Arsenical Sprays. By G. L. Sutton. *Journ. Agric., West. Australia* (1926, **3**, 2nd Ser., 221–225).

The Woolly Aphis Parasite (*Aphelinus mali*, Hald.). By W. B. Gurney. *Agric. Gaz., N.S.W.* (1926, **37**, 620–626).

The Woolly Aphis Parasite (*Aphelinus mali*, Hald.). By H. Jarvis. *Queensland Agric. Journ.* (1926, **26**, 105–108).

The Codling Moth (*Cydia pomonella*, Linn.). By H. Jarvis. *Queensland Agric. Journ.* (1926, **26**, 109–113).

Codling-Moth in Apricots. Report of Studies of Codling-Moth at Wellington during the 1925–26 Fruit Season. By F. W. Pettey and C. J. Joubert. *Journ Dept. Agric., Un. S. Afr.* (1926, **12**, 461–483).

La Banane d'exportation à la Guadeloupe. By A. Kopp. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 144–152).

La Production de Bananes en Guinée française. By J. Chillou. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 350–356).

The Banana Fruit-scarring Beetle (*Colaspis hyperchlora*, Lef.). By C. C. Gowdey. *Bull. Entom Res.* (1926, **17**, 137).

Panama Disease in Jamaica. By C. G. Hansford. *Microbiol. Circ. No.* 5, *Dept. Sci. and Agric., Jamaica.* Pp. 35, 9½ × 6. (Kingston: Government Printing Office, 1926.)

Le Dattier au Maroc. By P. Popenoe. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 129–136).

Physiological Studies of the Grape. By F. J. de Villiers. *Sci. Bull. No.* 45, *Dept. Agric., Un. S. Afr.* Pp. 97, 9½ × 6. (Pretoria: Government Printing and Stationery Office, 1926.) Price 1s. 6*d.*

Downy Mildew of the Vine (*Plasmopara viticola*) in New Zealand. The Disease and its Treatment. By J. C. Woodfin. *New Zealand Journ Agric.* (1926, **33**, 14–20).

Work and Parasitism of the Mediterranean Fruit Fly in Hawaii in 1921. By H. F. Willard and T. L. Bissell. *Journ. Agric. Res.* (1926, **33**, 9–15).

Queensland Fruit Fly (*Chaetodacus tryoni*, Froggart). By H. Jarvis. *Queensland Agric. Journ.* (1926, **26**, 101–104).

Fodders and Forage Plants

Experiments on Veld Management. First Report. By R. R. Staples. *Sci. Bull. No.* 49, *Dept. Agric., Un. S. Afr.* Pp. 35, 9½ × 6. (Pretoria: Government Printing Office, 1926.) Price 3*d.*

Intensive Pasturing Methods in Victoria. By W. H. Brown. *Agric. Gaz. N.S.W.* (1926, **37**, 671–683).

Nitrogenous Manuring of Pasture. *Journ. Min. Agric.* (1926, **33**, 498–502).

Phosphatic Fertilisers as Manures for Grass Land. By A. B. Adams. *Journ. Agric., W. Australia* (1926, **3**, 2nd Ser., 259–261).

The Ensilage of Sugar Beet Tops. By H. E. Woodman and A. Amos. *Journ. Agric. Sci.* (1926, **16**, 406–415).

La Culture des Azolla pour la nourriture des animaux de basse-cour et comme engrais vert pour les rizières. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 356–360).

Lucerne: Co-operative Manurial Experiments. By T. G. W. Reinecke. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 491–506).

The Pea Aphid as an Alfalfa Pest in Kansas. By R. C. Smith and E. W. Davis. *Journ. Agric. Res.* (1926, **33**, 47–57).

Staggers in Stock due to Rough-Bearded Grass (*Echinopogon ovatus*). By H. R. Seddon and H. R. Carne. *Agric. Gaz., N.S.W.* (1926, **37**, 684–690).

Cape Tulip (*Homeria miniata*). A Poison Plant. By J. F. Filmer. *Journ. Agric., West. Australia* (1926, **3**, 2nd Ser., 240–243).

Spices

Vanilla. By A. E. Collens and F. H. S. Warneford. Pp. 11, 9¾ × 6¼. (Leeward Islands, Superintendent of Agriculture, 1925.)

Oils and Oil-Seeds

Le Commerce et l'Industrie des Matières Grasses à Marseille en 1924. *Bull. Matières Grasses, Inst. Col. Marseille* (1926, No. 4, pp. 91–110).

Quelques succédanés africains des Beurres de Cacao. By A Baudon. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 92–95).

The Peanut (*cont.*). By H. Wenholz and G. Nicholson. *Agric. Gaz., N.S.W.* (1926, **37**, 613–619, *cont.*).

Sur les premières recherches de sélection du Palmier à huile à la Côte d'Ivoire (1922, début 1923) (*cont.*). By G. Lavergne. *Agron. Col.* (1926, **15**, No. 104, pp. 50–59; No. 105, pp. 102–119; *cont.*)

Les Concasseurs à noix de palme (*cont.*). By G. Passelègue. *Agron. Col.* (1926, **15**, No. 104, pp. 60–68; No. 105, pp. 81–95).

L'Emploi de Pressoirs à Vis pour l'Extraction de l'Huile de Palme. By MM. Houard, Lavergne, Castelli. *Bull. Matières Grasses, Inst. Col., Marseille* (1926, Nos. 5–6, pp. 111–124).

Compte-rendu des essais effectués à l'Huilerie expérimentale de la Ghaba (Tunisie) By M. Rousseau. *Bull. Matières Grasses, Inst. Col., Marseille* (1926, No. 7, pp. 163–193). [Experiments on Olives.]

Essential Oils

Kajoepoetih-olie. By D. B. Spoelstra. *Ber. Afdeeling Handelsmuseum, Kon. Ver. Koloniaal Instituut*, No. 25. Pp. 8, $8\frac{1}{2} \times 5\frac{1}{2}$. (Amsterdam: Kon. Ver. Koloniaal Instituut, 1926.) Price fl. 0·40. (Reprint from *Indische Mercuur*, 17 March, 1926.)

The Production of Essential Oils from Irish-grown Plants. Part I. Oil of Lavender. By J. Reilly, P. J. Drumm and C. Boyle. *Econ. Proc. Roy. Dublin Soc.* (1926, **2**, 273–284).

L'Aspic dans le Languedoc méditerranéen. By M. Paulet. *Parfumerie Moderne* (1926, **19**, 203–208).

Fibres

Contribution à l'étude technologique des fruits du *Bombax anguli-carpum*. By C. de Mello Geraldes, A. N. d'Almeida and C. da Silva Duarte. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 69–80).

The Broom Fibre Industry. *Journ. Agric. Victoria* (1926, **24**, 441–442).

Ricerche sulla fibra ricavata dallo stelo dello *Calotropis procera*. *Agricoltura Coloniale* (1926, **20**, 389–394).

Jute Cultivation in the United Provinces. By T. R. Low. *Agric. Journ. India* (1926, **21**, 380–382).

Études sur la Sélection du Lin. III.—Méthodes et résultats des croisements des Lins à fibres. By L. Blaringhem. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 193–204; 282–297).

Cotton

Cotton Cultivation in Ceylon. Sessional Paper X.—1926. Pp. 6, $13 \times 8\frac{1}{2}$. (Colombo: Government Printer, 1926.) Price 25 cents.

The Cotton Growing Problems of the Black Soils in India. By A. Howard. *Agric. Journ., India* (1926, **21**, 318–320).

Cotton in Nyasaland. By C. Ponsonby. *Emp. Cotton Grow. Rev.* (1926, **3**, 322–330).

Cotton-Growing in the Southern Sudan. By R. Hewison. *Emp. Cotton Grow. Rev.* (1926, **3**, 313–321).

L'Avenir de la Culture du Cotonnier en Algérie. By P. de Vilmorin. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 12–18; 95–102).

Le Cotonnier à la Côte d'Ivoire. By R. H. Lucky. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 278–282).

Die Baumwollkultur in Brasilien. By T. Bühler. *Tropenpflanzer* (1926, **29**, 295–303; 337–343; *cont.*).

The Improvement of the Cotton Plant. By T. Trought. *Agric. Journ. India* (1926, **21**, 305–312).

The Study of the Cotton Fibre. By A. J. Turner. *Agric. Journ. India* (1926, **21**, 274–294).

The Perfect Control of Cotton Seed. The Deterioration of Varieties and its Prevention. By W. L. Balls. *Emp. Cotton Grow. Rev.* (1926, **3**, 331–351).

Some Notes on the Red (Sudan) Bollworm (*Diparopsis castanea*, Hampson) in Nyasaland. By C. B. R. King. *Emp. Cotton Grow. Rev.* (1926, **3**, 352–364).

The Wilt Diseases of Cotton and Sesamum in India. By E. J. Butler. *Agric. Journ. India* (1926, **21**, 268–273).

Rubber

Para Rubber. By J. S. Camus. *Philippine Bur. Agric. Circ. No.* 191. *Phil. Agric. Rev.* (1926, **19**, 49–61).

La Culture de l'Hévéa au Congo Belge. By E. Leplae. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 204–218).

A Report on the Rubber Industry in Mindanao. By F. G. Galang. *Philippine Agric. Rev.* (1926, **19**, 3–47).

Methods of Increasing Yields on Rubber Plantations. By A. H. Muzzall. *Philippine Agric. Rev.* (1926, **19**, 75–83).

The Budding of Rubber on a Commercial Scale. By R. A. Taylor. *Trop. Agric., Ceylon* (1926, **67**, 86–89).

Eenige Opmerkingen omtrent de Bewaring en Verpakking van Oculatiehout. (Some Remarks Concerning Storing and Packing of Buddingwood.) By J. G. J. A. Maas. *Med. Alg. Proefsta., A.V.R.O.S., Rubberserie No.* 52. Pp. 12, 10½ × 7¼. (Buitenzorg, 1926.)

Rubber Tapping Experiments, Heneratgoda. By F. A. Stockdale. *Trop. Agric., Ceylon* (1926, **67**, 89–90).

Drie Korte Mededeelingen betreffende *Hevea brasiliensis*. A. Over de fasciaties bij *H. brasiliensis*. B. Extraflorale nectariën bij Hevea. C. Hevea boomen met groenen bast. By C. Heusser. *Med. Alg. Proefsta., A.V.R.O.S., Rubberserie No.* 49. Pp. 14, 10 × 7¼. (Buitenzorg: Archipel-Drukkerij, 1926.) [In Dutch and English.]

Rubber Tree Diseases and their Control. By N. G. Teodoro. *Philippine Bur. Agric. Circ. No.* 187. *Phil. Agric. Rev.* (1926, **19**, 63–73).

Plantations et Maladies de l'Hévéa. By E. de Wildeman. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 18–22).

De Spinnewebschimmels van *Hevea brasiliensis*. Three Kinds of Thread Blight on *H. brasiliensis*. By K. B. Boedjin. *Med. Alg. Proefsta., A.V.R.O.S., Rubberserie No.* 50. Pp. 8, 10 × 7¼. (Buitenzorg: Archipel-Drukkerij, 1926.) [In Dutch and English.]

Tobacco

Tobacco: Its Cultivation and Preparation. By G. Corbett. *Bull. No.* 33, *Gen. Ser., Dept. Agric., Mauritius*. Pp. 30, 10 × 6¼. (Port Louis: Government Printer, 1926.)

Tobacco Culture. A comparison of methods adopted in the United States and in Nyasaland. By A. J. W. Hornby. *Bull. No.* 1, *Agron. Ser., Dept. Agric., Nyasaland*. Pp. 89, 8½ × 6. (Zomba: Government Printer, 1926.)

Flue-Curing Tobacco Barns, Bulking and Grading Sheds (Revised). By P. H. Haviland. *Rhodesia Agric. Journ.* (1926, **23**, 722–732).

The Growing of Snuff Tobacco. By Ll. Worrall. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 396–405).

Cardiochiles nigriceps. Vier., an Important Parasite of the Tobacco Bud Worm, *Heliothis virescens*, Fab. By F. S. Chamberlin and J. N. Tenhet. *Journ. Agric. Res.* (1926, **33**, 21–27).

Diseases of Virginian Tobacco in South Africa. By E. S. Moore. *Journ. Dept. Agric., Un. S. Afr.* (1926, **12**, 428–455).

The Brown Root Rot of Tobacco and other Plants. By J. Johnson, C. M. Slagg and H. F. Murwin. *Dept. Bull. No.* 1410, *U.S. Dept. Agric.* Pp. 28, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Drugs

Les essais de culture des Arbres à Quinquina dans les Colonies françaises. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 42–48).

Conditions à réaliser pour que la culture des Arbres à Quinquina puisse prospérer dans nos Colonies. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 298–304).

Nieuwe Onderzoekingen over Cubeben. *Ber. Adfeeling Handelsmuseum, Kon. Ver. Koloniaal Instituut,* No. 26. Pp. 29, 8½ × 5½. (Amsterdam: Kon. Ver. Koloniaal Instituut, 1926.) Price fl. 0·40. (Reprint from *Indische Mercuur,* June 23, 30, 1926).

Miscellaneous Agricultural Products

Institute of Brewing Research Scheme. East Malling Research Station, Kent. Ninth Report on the Trial of New Varieties of Hops, 1925. By E. S. Salmon. *Journ. Inst. Brewing* (1926, **32** (23, N.S.), 442–453).

Observations on the Betel-nut Palm (*Areca Catechu,* Linn.) and Betel-nuts. By W. N. Sands. *Malayan Agric. Journ.* (1926, **14**, 202–218).

The Betel-nut Industry. By D. M. Grist. *Malayan Agric. Journ.* (1926, **14**, 219–230).

FORESTRY

General

Forests and Forestry. Statistical and other Information for Certain Countries. *Intern. Inst. of Agric., Bur. General Statistics.* Pp. 425, 9½ × 6¾. (Rome, 1925.)

Sixth Annual Report of the Forestry Commissioners, Year ending September 30, 1925. Pp. 32, 9½ × 6¼. (London: H.M. Stationery Office, 1926.) Price 9*d.*

Report on Forest Administration in the Andamans for the Year 1924–25. Pp. 69, 9¾ × 6½. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.5, As.8 (9*s.* 3*d.*).

Notes on Artificial Regeneration in North India. By S. H. Howard. *Indian For. Rec.* (*Silvicult. Ser.*) (1926, **12**, 233–269).

Report on the Forestry Department, Gold Coast, for the period April 1925—March 1926. Pp. 10, 13 × 8¼. (Accra: Colonial Secretariat; London: Crown Agents for the Colonies, 1926.) Price 1*s.*

Annual Report on the Forest Administration of Nigeria for the Year 1925. Pp. 29, 13 × 8¼. (Lagos: Government Printer, 1926.)

The Fifth Annual Report of the Forestry Department. Tanganyika Territory, 1925. Pp. 15, 13 × 8¼. (Dar-es-Salaam: Government Printer, 1926.) Price sh. 2/50.

The Trees of Extra-Tropical Australia. A Reconnaissance of the Forest Trees of Australia from the Point of View of their Cultivation in South Africa. A Report of a Tour in Australia in 1924. By C. C. Robertson. *Forest Dept., Pretoria.* Pp. 265, 12½ × 8¼. (Cape Town: Government Printers, 1926.) Price 10*s.*

Annual Report of the Forest Trust, British Honduras, for the Year ended March 31, 1926. Pp. 24, 13 × 8¼. (Belize: Clarion Press, 1926.)

Administration Report, Conservator of Forests, Trinidad and Tobago, for the Year 1925. *Council Paper No.* 74 *of* 1926. Pp. 14, 13 × 8¼. (Trinidad: Government Printing Office, 1926.) Price 6*d.*

The Trees of the Lower Río Motagua Valley, Guatemala. By S. J. Record and H. Kuylen. *Tropical Woods* (1926, No. 7, pp. 10–29)

Swietenia Mahagoni, Jacq. en *S. macrophylla,* King. By A. C. Noltée. *Med. Proefsta. Boschwezen,* No. 15, *Dept. Landb., Nijverheid en Handel, Ned.-Ind.* Pp. 125, 10½ × 7¼, with 30 plates. (Weltevreden, 1926.) [Summary in English pp. 95–101.]

Beschadigingen, Ziekten en Plagen van Mahonie (*Swietenia Mahagoni* en *S. macrophylla*), aangeplant op Java. By L. G. E. Kalshoven. *Med. Inst. Plantenziekten*, No. 69, *Dept. Landb., Nijverheid en Handel, Ned.-Ind.* Pp. 126, 10½ × 7½. (Weltevreden: Landsdrukkerij, 1926.) Price fl. 3·50. [Summary in English, pp. 107–126.]

Western Larch Nursery Practice. By W. G. Wahlenberg. *Journ. Agric. Res.* (1926, **33**, 293–300).

British Bark Beetles. By J. W. Munro. *Bull. No.* 8, *Forestry Commission.* Pp. 77, 9¾ × 6¼, with 16 plates. (London: H.M. Stationery Office, 1926.) Price 2*s.* 6*d.*

The Cyprus Processionary Caterpillar (*Thaumetopœa Wilkinsoni*, Tams). By D. S. Wilkinson. *Bull. Entom. Res.* (1926, **17**, 163–182).

Timbers

Native Woods used for Railway Crossties in British Honduras. By G. W. E. Francis. *Tropical Woods* (1926, No. 7, pp. 30–32).

Rapport à la Sous-Commission des Bois coloniaux de l'Association Colonies-Sciences sur un Plan de travail en vue de l'élaboration et la publication d'Études d'ensemble sur les Bois utilisables de la Forêt de l'Afrique tropicale et sur leur Classification. By A. Chevalier. *Actes et Compte-Rendus de l'Assoc. Col. Sci.* (1926, **2**, 17–25). [Suppl. to *Rev. Bot. Appl. Agric. Col.*, 1926, **6**, No. 54.]

Industrial Outlets for Short-length Softwood Yard Lumber. By E. M. Davis. *Dept. Circ.* 393, *U.S. Dept. Agric.* Pp. 59, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Relation of the Manner of Failure to the Structure of Wood under Compression Parallel to the Grain. By J. L. Bienfait. *Journ. Agric. Res.* (1926, **33**, 183–194).

The Furniture Mite (*Glycyphagus domesticus*, De Geer). *Econ. Leaflet No.* 2, *Brit. Mus.* (*Nat. Hist.*). Pp. 4, 8½ × 5½. (London: Natural History Museum. 1925.) Price 1*d.*

Tanning Materials

Les Palétuviers d'Indochine. Intérêt de leur exploitation, valeur technologique, comparaison avec des palétuviers d'autres origines (*cont.*). By F. Heim de Balsac, A. Deforge, J. Maheu and A. Parveaud. *Bull. Ag. Gén. Col.* (1926, **19**, 873–909).

Resins

Winning van Copal in het Gouvernement Celebes en Onderhoorigheden, de Uitvoer hiervan uit Makassar, en eenige Details over het Gebruik van Copal. By C. Van de Koppel. *Teysmannia* (1926, **19**, 525–569; summary in English, pp. 570–572).

NOTICES OF RECENT LITERATURE

THE TRADE, INDUSTRIES, PRODUCTS, ETC., OF SOUTH AFRICA AND ADJACENT TERRITORIES: A BUSINESS AND GENERAL HANDBOOK. Compiled from Official Sources by C. W. Francis Harrison, F.S.S., F.R.G.S. Pp. 550, 9½ × 7¼. (Pietermaritzburg: The Natal Witness, Ltd., 1926.) Third issue. Price 21*s.*

This is a well printed and practical handbook, which should be of considerable utility to readers interested in the commerce or industry of South Africa, Southern

Rhodesia and Portuguese East Africa. To some extent it serves as a commercial directory for the region. The information regarding the Union of South Africa, which occupies the greater part of the volume, is divided into twelve sections, consisting largely of statistical and other useful tabular matter, but also including much information on the principal agricultural and mineral products of the Union. The book contains a number of local views and other illustrations.

PLANT NUTRITION AND CROP PRODUCTION. By E. J. Russell. Pp. ix + 115, 9 × 6. (Berkeley, California: University of California Press; London: Cambridge University Press, 1926.) Price 12*s*. 6*d*.

This volume contains the Hitchcock Lectures for 1924 delivered by Sir John Russell for the American Hitchcock Foundation in the University of California. The lectures were established in 1909 and the present series are the first which have been concerned with the science of agriculture. There are five chapters in the book dealing respectively with plant nutrients, the methods of exact demonstration, decay and the living plant, soil micro-organisms, and the soil and the living plant. The subject matter is essentially a review of the present position of the topics discussed, and, while much of the ground covered is familiar to students of the work at Rothamsted, once more Sir John Russell has presented the case with freshness. The first lecture must have been specially attractive to an American audience, for "The Study of Plant Nutrients" has been made to provide an opportunity of relating much of personal interest concerning Gilbert and Lawes, and of exhibiting most interesting illustrations relating to Rothamsted, among which may be specially mentioned the photographs of the original barn laboratory and of pages from the notebooks of Gilbert and Lawes.

FIELD CROPS OF CENTRAL AFRICA. By J. R. Fell. Pp. 83, 7 × 5. (London: The Christian Literature Society for India and Africa.) Price 1*s*.

The author of this excellent little book is principal of the Native Training Institute at. Kafue, Northern Rhodesia. There is no explanatory preface, but the volume is clearly intended as a field guide for English-reading natives and through them for others with fewer advantages. It will also be read with pleasure and profit by white agriculturists. The field crops dealt with are those commonly met with in Rhodesia and may be grouped

as follows: cereals and legumes, comprising maize, kaffir corn, rice, peanut, cowpea, velvet bean; sweet potato and cassava; cotton and hibiscus as fibre plants; sugar; the oil-seeds castor and sunflower; fruits represented by the banana, pineapple, papaw, mulberry, pomegranate, mango and guava; coffee; tobacco. The information given is arranged under useful headings and is at once simple, practical and adequate. The text and style are admirably adapted for the purpose in view and there does not appear to be a "hard" word or a superfluous word in the book, which contains a surprising amount of useful particulars. There are also a glossary and a number of illustrations. It is to be hoped, however, that Burma receives more than "about £10,000 for the rice it sells every year."

THE CULTIVATION OF CITRUS FRUITS. By H. Harold Hume. Pp. xxi + 561, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: Macmillan & Co., Ltd., 1926.) Price *21s.*

This is probably the most comprehensive book on citrus cultivation that has yet been written.

The confusion in botanical classification that has hitherto confronted anyone attempting to write about citrus fruits on a scientific basis is discussed, and the classification adopted is that of W. J. Swingle, of the United States Department of Agriculture, who has made an extensive study of the subject. The term "citrus fruits" is retained as a convenient designation, but two generic names other than *Citrus* are introduced, the kumquats being referred to the new genus *Fortunella*, and *Poncinus trifoliata*, Raf., being restored for the trifoliate orange.

Botanical descriptions are given of the citrus plants and a number of related plants, and the different citrus fruits are dealt with historically, geographically, and from the point of view of commercial importance.

The breeding of new varieties and the propagation of citrus trees form the subjects of separate chapters, in which the technique of the processes involved is described, whilst another chapter deals with stocks used for growing citrus fruits and the considerations determining their choice. The selection of localities for citrus groves, as affected by soil and other factors, their preparation, planting and cultivation, are dealt with, as are also the questions of cover-crops, manuring, irrigation, the pruning of the trees, and the harvesting and marketing of the fruit. A chapter devoted to the protection of the trees against the effects of frost deals with considerations that are probably of

greater moment in the United States than in the majority of citrus-growing countries of the British Empire.

Insect pests and diseases affecting citrus trees are described and the methods of combating them are discussed, instructions being given for spraying, dusting, and fumigating. Finally there is an interesting chapter entitled " Fungous and Insect Friends."

The numerous illustrations in the text, most of which are photographs, add considerably to the usefulness and attractiveness of the work. The book is written throughout from the standpoint of the American grower, but the whole of it will be of interest, and the greater part of considerable practical value, to citrus growers in other countries.

CITRUS DISEASES AND THEIR CONTROL. By Howard S. Fawcett, with Sections on Oriental Citrus Diseases by H. Atherton Lee. Pp. xii + 582, $9\frac{1}{4} \times 6\frac{1}{4}$. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 25*s*.

With the world-wide cultivation of citrus fruits it was to be expected that the plants would be attacked by a great variety of fungi. Even the citrus grower, however, when he looks through this excellently prepared book will be surprised at the enormous number of diseases attacking the different parts of the plant. Fortunately only a few are of such a serious nature as to require drastic measures of control and constant attention to prevent their attack. Owing to the differences in climatic and other conditions of the various citrus-growing countries a major disease in one country may be only of minor importance or entirely absent in another. Nevertheless it is important that the grower should be in a position to recognise and treat any disease which may appear in his crop and this book will be of great value from this point of view.

The authors were eminently qualified to prepare such a treatise. Both have investigated citrus diseases at first hand, Professor Fawcett in Florida and California, the two great centres of citrus production in the United States, and Mr. Lee in Hawaii and the Philippine Islands. Their work naturally figures very largely in the present volume, but they have also brought together the results of the researches of other workers in all parts of the world, and the very full bibliography which is given will prove of great value.

The first part of the book is devoted to general considerations, including the nature of fungi ; the geographical distribution of citrus diseases and the conditions affecting their severity and distribution ; general principles of the

prevention and treatment of the diseases, with a brief description of the more important fungicides, disinfectants, paints and waxes employed in their control; and cultural operations in relation to citrus diseases.

The description of the various diseases is arranged for convenience of reference and identification into groups, corresponding, in general, to the parts of the tree affected, viz. (1) roots and trunk, (2) branches, twigs and leaves, and (3) fruit, and in accordance with the general appearance or similarity of the lesions or effects. A key is provided in each of the three sections as an aid to identification, whilst the numerous reproductions from photographs and a number of excellent coloured plates will also be of much value for this purpose.

The authors have adopted the term disease in its wide sense to include all deviations from the usual or normal structure or function sufficient to threaten life or impair the economic usefulness of the plant. Effects due to environmental and nutritional influences are consequently dealt with as well as those caused by fungi. Certain diseases due to insects have also been included, because the lesions or effects produced by them are frequently mistaken for those caused by vegetable organisms or because the injuries they inflict serve as contributory factors to infection by and development of the latter.

COTTON AND ITS PRODUCTION. By W. H. Johnson. With an introduction by Sir Wyndham Dunstan, K.C.M.G., LL.D., F.R.S., and a foreword by Sir William Himbury. Pp. xxv + 536, 9 × 6. (London: Macmillan & Co., Ltd., 1926.) Price 30*s.* net.

This book gives a detailed and comprehensive account of cotton cultivation and production throughout the world. Such a work was greatly needed and its appearance will be cordially welcomed.

Mr. Johnson's wide agricultural experience in both East and West Africa, as well as his practical acquaintance with cotton-growing in Ceylon, South Africa, Rhodesia, Australia and the United States, has peculiarly fitted him for the collection and compilation of the vast amount of information contained between the covers of this book.

The work opens with a brief historical survey of the production and utilisation of cotton, and this is followed by a practical description of the cotton plant and its varieties. An account is then given of cotton production in the various countries of the world, which are considered in the following order: United States, India, Egypt,

Brazil, China and Russia, the British Empire (other than India) and minor cotton-growing countries.

Later chapters deal with cotton cultivation in all its phases, including the improvement of the cotton plant by selection and hybridisation, the occurrence and control of pests and diseases, and the handling and marketing of the cotton crop. An outline is given of the chief manufacturing processes to which cotton is subjected, and brief reference is made to cotton seed and other by-products of the industry.

In an interesting introduction Sir Wyndham Dunstan briefly indicates some of the chief factors which have assisted the development of cotton-growing in the British Empire since the beginning of the present century. He also refers to the possibility of the replacement of cotton to some extent by artificial silk in the following words: "The possibility of the artificial production of cotton or of an efficient cotton substitute, from an abundant raw material such as wood, cannot be entirely discounted. The production from wood of a useful fibre, wrongly known as 'artificial silk,' will probably diminish to some extent the use of cotton for certain textile purposes, and it is not impossible that a fibre more nearly resembling cotton may be produced artificially by similar means." In this connection it is of interest to note that at the Annual Meeting of the British Cotton Industry Research Association on September 14, 1926, it was suggested that an artificial silk department of the Association should be created.

In the foreword Sir William Himbury gives a general account of the establishment and work of the British Cotton Growing Association.

The work contains twenty-six useful maps of the various cotton-growing countries, in which the cotton areas are indicated in green.

The volume can be recommended to all who are interested in any way in the cultivation and production of cotton.

THE COTTON GROWING COUNTRIES, PRESENT AND POTENTIAL. Production, Trade, Consumption. Pp. xxxvi + 317, $9\frac{1}{2} \times 6\frac{3}{4}$. (Rome: International Institute of Agriculture; London: P. S. King & Son, Ltd., 1926.) Price 12*s*. 6*d*.

In 1922 the International Institute of Agriculture issued a useful publication entitled *Cotton Growing Countries: Production and Trade*, which was noticed in this BULLETIN (1923, **21**, 410). The information given in that report on the position and prospects of cotton-growing

in the various countries of the world has been expanded and brought up to date in the present work. The data have been carefully compiled and the book forms a valuable work of reference for all who are interested in the production and utilisation of cotton.

DISTILLATION DES PLANTES AROMATIQUES ET DES PARFUMS. By R. M. Gattefossé. Pp. ii + 152, 8½ × 5½. (Paris: Desforges, Girardot & Cie., 1926.) Price 16 frs. 50 (2*s*. 4*d*.)

This work, by the well-known French authority on essential oils, commences with a historical introduction to the subject, and descriptions are then given of the primitive distillation apparatus still employed in the East. There is a useful little chapter on the theory of distillation, which is followed by a thorough discussion of the construction and efficiency of various types of alembics and condensers, and the evolution of modern plant. The author points out the defects of some modern distillation apparatus, and indicates how these may be overcome. A good deal of attention is given to the conservation of water and fuel, and also to the recovery of oil dissolved in the aqueous distillate. Further chapters deal with the rectification, fractionation, and deterpenation of oils, and with apparatus for extraction by means of organic solvents. The usefulness of the work is enhanced by the numerous illustrations of apparatus which are provided.

SYNTHETIC RUBBER. By S. P. Schotz, D.Sc. Tech. (Zürich), B.Sc. (Honours, London), A.R.T.C. (Glasgow), F.I.C. Pp. 144, 10 × 7½. (London: Ernest Benn, Ltd., 1926.) Price 21*s*.

The rise in the price of plantation rubber during the past two years and the uncertainty as to how far future supplies will meet the increasing demand have resulted in renewed attention being given to the synthetic product. The present volume contains a detailed account of those methods of manufacture, the simplicity or cheapness of which Dr. Schotz considers renders them suitable for industrial application, and purely scientific considerations have had to take second place. No information is given, however, as to the approximate cost of the raw materials or of the processes suggested.

About half the book is devoted to methods for the production of the hydrocarbons used as sources of synthetic rubber, namely isoprene, butadiene, and dimethylbutadiene. The difficult problem of converting these raw materials into synthetic rubber by polymerisation is then

dealt with, and although particulars are given of a great variety of processes it is clear that, as Dr. Schotz admits, there is still a wide field for further experimental work. Shorter chapters follow on vulcanisation, stabilisation, properties and constitution of natural caoutchouc and synthetic rubber, and the history of synthetic rubber. Illustrations of a selection of plant and machinery, together with a name and subject index, complete the book.

This volume gives an excellent summary of the results obtained in the investigation of a difficult and complex problem by chemists of various nations, and forms a very useful addition to the technical literature on rubber.

Gum Arabic with Special Reference to its Production in the Sudan. By H. S. Blunt, M.A. Pp. 45. 11 × 7½. (Oxford: University Press; London: Humphrey Milford, 1926.) Price 10*s.* 6*d.* net.

The present work is a record of some of the author's observations during five years' work as Assistant Conservator of Forests in one of the main gum-producing districts of the Southern Sudan. It deals chiefly with the history, botany, origin, exploitation, properties and uses of gum arabic, together with its markets, freights, the Government royalty, and the forest policy.

" Sudan " or " Kordofan " gum was formerly shipped to Arabian ports, and thence to Europe; hence the designation " gum arabic." At the present time practically all the gum leaves the country through Port Sudan. The gum tree (*Acacia Senegal*, Willd.) is found chiefly on sandy hills, where it grows to a height of 4 to 5 metres. It appears to live for twenty-five to thirty years and to produce gum between the ages of four and eighteen years. Full details are given of the method of tapping, which is carried out during the dry season, approximately from October to May. Tapping is a comparatively recent practice and has been found to increase the yield about five-fold.

A. Senegal apparently yields gum only when in an unhealthy condition, which may be due to extreme poorness of soil, lack of moisture, and its stunted growth, for all steps which have been taken to improve the state of the trees have resulted in a reduction of the yield of gum.

About two-thirds of the Sudan gum is produced in Kordofan Province, and markets have been established at El Obeid, Nahud, Um Ruaba and Rahad. Up to 1922 the Arabs disposed of their gum in the markets through brokers, but in 1924 all gum markets in the Province were

placed under the Assistant Conservator of Forests, and auctions conducted by a Government clerk. This system gives satisfaction to both buyer and seller. The book contains some excellent photographs which add considerably to its value and it will undoubtedly be useful to all interested in this important Sudanese product.

CHEMISTRY OF THE PROTEINS AND ITS ECONOMIC APPLICATIONS. By Dorothy Jordan Lloyd, M.A. (Cantab.), D.Sc. (Lond.), F.I.C. Pp. xii + 279, 8 × 5½. (London: J. & A. Churchill, 1926.) Price *10s. 6d.* net.

This work is based on a course of lectures given by the author at the Battersea Polytechnic on "The Chemistry of the Proteins and its Industrial Applications." It provides a concise account of protein chemistry, the first part being devoted to the constitutional chemistry of these substances and the second part to their physical chemistry.

In the introduction Sir F. Gowland Hopkins states that "while treating with completeness from a chemical standpoint each of these broad divisions of the subject, the book contains references to every important application of the facts. Their bearing upon general biochemistry and upon physiology and pathology is consistently indicated throughout, and even their commercial applications receive due notice. Although so exhaustive, the work is no mere compilation. It is written from a standpoint which is fully critical, though it does not exclude reference to views which, while not yet proven, are suggestive and stimulating." There are interesting chapters on the chemistry of protein foods and the problems of food preservation, and notes on the industrial uses of the proteins, including reference to wool and silk, collagen and leather manufacture, adhesives, glazes, varnishes, distempers and sizes, and gelatin.

The work will be of much service to students of biochemistry and physiology, and the useful bibliography given at the end of each chapter will enable them to obtain more detailed information on any branch of the subject regarding which they may desire specialised knowledge.

THE LEATHER TRADES' YEAR BOOK, 1926. Edited by Dr. J. Gordon Parker on behalf of the Joint Standing Committee of the United Tanners' Federation and the Federation of Curriers, Light Leather Tanners and Dressers, Inc. Pp. 122 + xlvi, 9 × 6. Price 5s.

This year book, now in its twenty-fourth year, contains full particulars of the organisations associated with the leather industry of the United Kingdom, their officers

and members, and twenty-six pages of statistics relating to the production of tanning materials, leather, hides and skins, and the number of cattle in various countries. In addition there are five special articles dealing with (1) Recent Advances in the Chemistry of Leather Manufacture, (2) The Statistical Basis of the United States Leather Industry, (3) The Rôle of Oxidation in Leather Manufacture, (4) A Leather Industry in Spain, and (5) Sumach: its Cultivation, Analytical Content and Utilisation.

AIMS AND METHODS IN THE STUDY OF VEGETATION. Edited by A. G. Tansley, M.A., F.R.S., and T. F. Chipp, M.C., B.Sc., Ph.D. Pp. xvi + 383, 9 × 6. (London: The British Empire Vegetation Committee and the Crown Agents for the Colonies, 1926.) Price 12*s.* 6*d.* post free.

At the first Imperial Botanical Conference, held in London in 1924, a resolution was passed to set up a British Empire Vegetation Committee whose work should be to encourage and promote the survey and study of the vegetation of the Empire. The present book is the first fruit of the activity of this Committee. Its object is to outline the aims, opportunities and methods of exploring, recording and investigating the vegetation of different parts of the Empire, a line of study which, properly carried out, is essential to the fullest development of the vast agricultural and forest resources of the Empire.

The book is divided into three parts. Part I (by the Editors) begins with a general statement of the nature and aims of the study of vegetation. Then follows an outline of what the authors consider to be the best way to analyse vegetation into units which can be conveniently dealt with, a scheme based on that put forward by Dr. F. E. Clements in his work, *Plant Succession*. The methods of investigating particular examples of vegetation are described and notes are given on collecting and preserving specimens. The various factors which mould vegetation —climate, soil, animals and man—are discussed, and practical methods for the study of these factors are described and suggested. This part concludes with three papers on groups of plants which require special methods of study, Mr. J. Ramsbottom dealing with fungi and lichens and Mr. A. D. Cotton with seaweeds.

Parts II and III have been contributed by workers who have had experience overseas. Regional topics are dealt with in Part II, Dr. Chipp describing the aims and methods of study in tropical countries, with special reference to West Africa; Dr. L. Dudley Stamp deals with some special

aspects of vegetation survey in the tropics; Professor J. W. Bews with vegetation study in sub-tropical countries, Dr. T. G. B. Osborn with methods of work in semi-arid and arid Australia, whilst Dr. Leonard Cockayne supplies notes on ecological field work in New Zealand. In Part III various types of vegetation are described, Professor R. S. Troup dealing with problems of forest ecology in India, Professor Bews with forest vegetation and grasslands in South Africa, Professor C. D. Howe with forest investigation in Canada, and Dr. Cockayne and Dr. H. H. Allan with a number of aspects of vegetation in New Zealand.

It will be seen that the book contains the views of some of the most successful workers in the Empire as to the equipment and methods of work which they have found most useful in the field. For this reason it should be of very great service to all officials and other field-workers who are taking their share in the development of the Empire's forest and agricultural resources.

In order that the book may be supplied at as low a price as possible it is being distributed through voluntary agents in different parts of the Empire, instead of through booksellers in the ordinary way. Copies may be obtained direct from the Crown Agents for the Colonies, 4, Millbank, Westminster, London, S.W., or from the Secretary to the British Empire Vegetation Committee, Dr. T. F. Chipp, 199, Kew Road, Kew, Surrey, England.

BOOKS RECEIVED FOR NOTICE

MAIS. By Prof. Dr. A. Eichinger. Bangerts Auslandbücherei, Bd. 32. Reihe; Wohltmann-Bücher Monographien zur Landwirtschaft warmer Länder, Band 5. Pp. viii + 183, 7½ × 5. (Hamburg: Deutscher Auslandverlag Walter Bangert, 1926.) Price Rm. 5.

FERTILIZERS. THEIR SOURCES, MANUFACTURE, AND USES. By Herbert Cave. Pp. xi + 116, 7½ × 5. (London: Sir Isaac Pitman & Sons, Ltd.) Price 3s. *6d.*

CATALYSIS IN THEORY AND PRACTICE. By Eric K. Rideal and Hugh S. Taylor. Pp. xv + 516, 9 × 6. (London: Macmillan & Co., Ltd., 1926.) Price 20s.

COMMERCIAL AIR TRANSPORT. By Lieut.-Col. Ivo Edwards, C.M.G., and F. Tymms, M.C., with a Foreword by Air Vice-Marshal Sir Sefton Brancker, K.C.B., A.F.C. Pp. xv + 163, 8½ × 5½. (London: Sir Isaac Pitman & Sons, Ltd., 1926.) Price 7s. *6d.*

CONTENTS

VOL. XXIV. NO. 4

PART B—MINERAL RESOURCES

PART B—MINERAL RESOURCES

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Colonial and Indian Governments

BAUXITE FROM NYASALAND

THE fact that important deposits of bauxite occur in the Luchenya Plateau was first observed by officers of the Geological Survey of Nyasaland in September 1924. Subsequent investigation showed that the mineral also occurs to a smaller extent in other parts of the Mlanje mountains. An interesting account of the deposits has been given by the Government Geologist in the *Mining Magazine*, 1925, **23**, 201–5.

Luchenya Plateau consists of rolling grassy uplands situated at an elevation of about 6,000 ft. at the head of the Luchenya River. The principal deposit of bauxite extends over an area of at least 2 square miles, and over much of this the mineral ranges from 15 to 30 ft. in depth.

Preliminary analyses of the surface bauxite having given promising results, a series of samples mainly taken from small shafts and adits at depths of 10 to 50 ft. below the surface of the deposit were forwarded to the Imperial Institute for examination.

The eleven samples of bauxite, which are the subject of the present report, and which were forwarded to the Imperial Institute in June, 1925, by the Government Geologist, were sent in order that they might be submitted to chemical analysis and their suitability for various industrial purposes thus ascertained.

Description of Samples

Sample No.	Location.	Depth from surface of deposit.	Description.
1	Shaft 2	15 ft.	Soft rubbly pinkish bauxite.
2	Adit 2*a*	30 ft.	Soft rubbly pinkish bauxite, containing some free quartz.
3	Adit 2*b*	40 ft.	Soft rubbly pinkish bauxite, containing some free quartz.
4	Shaft 3	13 ft.	Soft rubbly pinkish bauxite.
5	Shaft 5	20 ft.	Hard compact red bauxite.
6	Adit 5*a*	35 ft.	Soft rubbly pinkish bauxite.
7	Shaft 6	10 ft.	Soft rubbly pinkish bauxite.
8	Adit 7*d*	50 ft.	Dark reddish-brown bauxite, showing grains of ilmenite.
9	Various	15 to 30 ft.	Gritty hard red bauxite, containing much free quartz.
10	Boma Road	Road cutting	Cream-coloured porous friable bauxite, containing much free quartz and occurring around margins of the main deposit.
11	Near Forester's Cottage	Surface	Similar to No. 9, but containing less free quartz.

Samples Nos. 1 to 8 were stated to represent the common types of ore found in the main deposit.

Results of Examination

Representative samples of the specimens were submitted to chemical analysis with the results shown on the opposite page.

Of these analyses, it is of interest to compare those of samples Nos. 1 to 8 which, as already stated, were made on samples of the bauxite taken at depths greater than 10 ft., with analyses recorded as follows by the Government Geologist (*Mining Magazine*, loc. cit.) of samples taken at or near the surface of the deposit :

—	Surface of ground near Forester's Cottage.		Ore exposed in shafts Nos. 1 to 6 at 6 ft. depth.
	Per cent.		*Per cent.*
Alumina Al_2O_3	62·08	59·80	57·63
Ferric oxide Fe_2O_3	4·00	7·00	10·35
Silica SiO_2	1·21	1·70	1·70
Water	31·96	30·54	29·92

It may be remarked that the Government Geologist estimates that if an average depth of 7 ft. of workable ore be assumed, then the Luchenya deposit contains not less than 20 million tons of bauxite.

Sample No.		1	2	3	4	5	6	7	8	9	10.	11.
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent.*
Alumina	Al_2O_3	53·21	50·04	46·77	53·48	47 04	50 33	53·75	43·94	43·54	46·22	52·42
Ferric oxide	Fe_2O_3	13·02	11·88	13·10	11·88	14 98	13·43	11·80	22 06	13·84	5·21	11·43
Titanium dioxide	TiO_2	1·52	1·36	1·89	1·64	1·54	2·08	1·73	3·58	1·30	0·90	1·21
Lime	CaO	0 28	0·44	0·44	0·40	0·36	0 34	0·32	0·52	0·52	0·32	0·30
Magnesia	MgO	0 11	0 28	0·44	0·18	0·18	0·26	0·24	0·44	0·44	0·14	0·30
Silica	SiO_2	1·84	9·04	11·50	1·96	9·14	5·10	2·56	2·62	15·00	15·98	1·95
Loss on ignition *		29·92	26·88	24·92	30·66	26·72	28·85	29·90	26 82	25·13	30·46	32·15
* Including Moisture lost at 100° C.		0·72	0·78	0·92	0·74	0·70	0·56	0·30	1·00	0·64	3·77	1·11

If the present samples Nos. 1 to 8 be considered as representative of the average of the ore from the lower portion of the main deposit, then such average ore would have the following composition:

		Per cent.
Alumina	Al_2O_3	49·82
Ferric oxide	Fe_2O_3	14·02
Titanium dioxide	TiO_2	1·92
Lime	CaO	0·39
Magnesia	MgO	0·27
Silica	SiO_2	5·47
Loss on ignition		28·08

This analysis, however, indicates a much lower grade ore than that represented by the analysis (quoted on page 732) of material taken from shafts 1 to 6 at a depth of 6 ft.

If, however, the samples obtained at 10 to 15 ft. from the surface (i.e. Nos. 1, 4 and 7) be considered, it will be seen that their average analysis would show the following percentages: alumina, 53·48; ferric oxide, 12·23; silica, 2·12. Such an ore would be of much better quality than one represented by the average of analyses Nos. 1 to 8 quoted above.

It appears, therefore, that the quality of the bauxite in this district tends to decrease after a depth of about 6 ft. has been passed; but in view of the Government Geologist's estimate of 20 million tons of surface ore available it seems probable that ample supplies of the better quality ore are available to meet demands in the immediate future.

In connection with the possible industrial utilisation of the bauxites occurring between 15 to 50 ft. from the surface, it may be of interest to consider the four main outlets for bauxite, i.e.:

(1) the manufacture of metallic aluminium;

(2) chemical purposes such as the production of salts of aluminium;

(3) as a constituent of aluminous cement, and

(4) refractory and other purposes.

Manufacture of Metallic Aluminium.—The specifications adopted by buyers of ore for the production of

aluminium vary considerably, but usually a minimum of 52 per cent. of alumina (Al_2O_3) is required, while the silica should not exceed 3 per cent. Titanium dioxide is usually considered objectionable if present to the extent of more than 4 per cent.

It appears, therefore, that of the present samples Nos. 3, 5, 8, 9 and 10 would be unsuitable for use in the manufacture of metallic aluminium on account of their content of alumina falling below 50 per cent. The large amount of silica present would cause samples Nos. 2, 3, 5, 9 and 10 to be rejected.

The remaining samples, Nos. 1, 4, 6, 7 and 11, all contain larger amounts of iron than is considered permissible in bauxites of good quality, but they otherwise conform to the requirements of aluminium manufacturers. These latter samples would be comparable with the red varieties of French and Dalmatian bauxite, of which large quantities have been utilised in the past.

Aluminous Cement.—As a general rule bauxite considered most suitable for making aluminous cement contains about 52 per cent. of alumina, from 10 to 15 per cent. of silica, and a fairly large percentage of ferric oxide.

It is probable that, of the present samples from Nyasaland, Nos. 1 and 2 would be suitable for use in the manufacture of aluminous cement.

Samples Nos. 3, 5, 9 and 10 are suitable as regards the proportions of silica and iron present, but the alumina content in each case is low. The quantity of silica is too low in samples Nos. 4, 6, 7, 8 and 11, which would be suitable in other respects. Possibly, however, mineral from several shafts could be blended in order to obtain a mixture of the desired composition.

Chemical Purposes.—It is usually necessary for bauxite intended for use in the chemical industry to contain over 50 per cent. of alumina, and only low percentages of iron oxide and titanium dioxide (usually under 3 per cent. of each). The quantity of silica allowed varies considerably, but a maximum of 5 per cent. is frequently adopted.

It is evident, therefore, that material represented by any of the present samples from Nyasaland would not be

suitable for use in the manufacture of aluminium salts on account of the high percentage of iron oxide present.

Refractories, etc.—Bauxite for refractory purposes should, as a general rule, contain only small quantities of iron oxide and titanium dioxide, but a considerable proportion of silica may be present. Sample No. 10 and possibly Nos. 2, 4, 7 and 11 might be employed for refractory purposes, although the iron content is rather high in all samples except No. 10.

Bauxite is used to some extent in the refining of petroleum distillates, but there is no general specification for such material, and its value for the purpose depends on certain physical characteristics of the ore. The value of any particular bauxite for oil refining can only be determined by practical trials with the oil which is to be treated.

It is unlikely that any of the present samples of bauxite would be suitable for the manufacture of artificial abrasives (such as alundum), for which purpose a high-grade ore, low in oxides of iron and titanium, is usually required.

Summary and Conclusions.—None of the eleven samples of bauxite taken from the lower portions of the Mlanje deposit is of high grade, all being inferior to the material obtainable nearer the surface, of which large reserves are said to be available.

Samples Nos. 1, 4, 6, 7 and 11 could possibly be used for the manufacture of metallic aluminium, although they do not represent the grade of ore considered most suitable for this purpose.

For the manufacture of aluminous cement it is possible, perhaps, that material represented by samples 1 and 2 could be employed.

Refractory bricks could be made from sample No. 10, and possibly also from Nos. 2, 4, 7 and 11.

None of the present samples of bauxite would be suitable either for chemical purposes or for use in the production of artificial abrasives.

ARTICLE

THE MINERAL INDUSTRY OF INDIA

Owing to the difficulty of collecting full statistics over such a large area, it is not possible to give exact figures of India's mineral production. The figures that are available, however, give ample proof of the rapid progress of the mineral industry. The Geological Survey of India issues the most complete figures and, for convenience, divides them into two groups, Group I including those minerals for which reliable returns are available, while Group II covers those for which only partial returns are obtainable, or none at all. The fact that each of these groups comprises some twenty minerals indicates the great variety of India's mineral wealth.

In 1904, the value of mineral production shown in Group I was £5,364,016. In 1924 the corresponding value was £27,831,294, while the total recorded production was valued at £28,634,996. In 1925, the total was £27,513,960. That the growth has been progressive and therefore healthy is shown by the last three quinquennial averages, viz.:

1909–1913 . . .	£8,393,222
1914–1918 . . .	£11,822,743
1919–1923 . . .	£24,615,727

The Indian Empire has a total area of about 1¾ million square miles with a population of 320 millions. As the standard of living of this immense population rises the demand for minerals of all kinds will continue to expand in proportion. The growth of the coal industry and the rapid expansion now taking place in the iron and steel industry are signs that this demand is already being felt.

A large part of India's mineral production has had to be exported owing to a limited home market. As the latter grows the price obtainable will be higher by reason of saving in transport charges, while the full value of the finished article will be realised in India instead of that of the raw material only. Signs are not wanting that India will in future be exporting finished materials in place of

raw materials, thus entering into competition in the world market. Coal has been an important export for many years, and, recently, pig-iron has been exported in large quantities, the amount being 401,794 tons in 1925. Lead also is being exported in important quantities, while zinc and copper may be exported in the near future, as smelting schemes for the recovery of both these metals are under consideration.

India is the most important producer of manganese ore in the world at the present time, and has been in a leading position for many years. The same is true for mica, monazite and natural saltpetre.

In recent years important developments have taken place in India in respect of ores of iron, chromium, tin, tungsten, lead, zinc, copper and aluminium, as well as significant increases in production of various non-metallic ores and ores of minor metals. Greater attention is being given to educational work of an economic character, which should result in more active prospecting and speedier development of new discoveries. In addition to the numerous existing technical institutions, a mining school has been established at Dhanbad, in proximity to the more important coalfields.

India is made up of three distinct parts, differing considerably from one another, these differences corresponding broadly with geological and physical variations.

(1) *Peninsular India,* forming, with the island of Ceylon, a triangular plateau, consists of an old land area built up chiefly of ancient rocks, mostly pre-Cambrian, but including the important coal-bearing formations. In the ancient rocks occur the principal ore deposits, viz. those of gold, iron, manganese and copper, and of non-metallic minerals such as mica, corundum, gemstones, ornamental stones and building slates.

(2) *Extra-Peninsular India,* comprising the mountainous region on the west, north and east, and including the Province of Baluchistan. The rocks of this region are representative of all the main geological periods from the Cambrian to Tertiary, and contain important deposits of petroleum and rock-salt, as well as numerous building stones and other materials of economic value.

(3) *The Indo-Gangetic Plain*, lying between (1) and (2) and extending from the valley of the Indus, in Sind, to that of the Brahmaputra, in Assam. It includes the most densely populated provinces in India, Bengal and the Punjab, but is of less interest from the mineral resources point of view, as the bed rocks have for the most part a thick covering of alluvium.

For details relating to the geology of the country, readers should consult *The Geology of India*, by D. N. Wadia.

In the following more detailed discussion of India's mineral industry and recent developments, it is proposed to follow the order adopted by the Geological Survey, i.e. minerals in order of value of production in 1924, as shown in the following table (*Rec. Geol. Surv. India*, 1926, **59**, pt. 3).

Value of Indian production of minerals for which returns are available for the years 1924 *and* 1925.

	1924. £(£1=Rs. 13·9/-).	1925. £ (£1=Rs. 13.3/-)
Coal	10,766,433	9,503,828
Petroleum	7,559,233	7,740,727
Manganese ore [1]	2,719,949	2,617,220
Gold	1,827,433	1,673,501
Lead and lead ore	1,694,679	1,666,726
Silver	810,869	705,503
Building materials	733,117	853,851
Salt	700,717	574,628
Mica [2]	679,796	799,483
Iron ore	279,610	336,775
Tin and tin ore	208,179	267,931
Saltpetre [2]	201,382	147,617
Copper matte	114,714	262,297
Zinc ore [2]	83,486	156,375
Jadeite [2]	50,849	12,237
Chromite	42,259	40,171
Ruby, sapphire and spinel	34,773	27,454
Clays	25,178	21,795
Tungsten ore	24,559	33,975
Magnesite	21,088	31,179
Bauxite	13,531	6,320
Monazite	9,301	—
Gypsum	5,527	5,810
Other minerals	28,334	28,557
Total	28,634,996	27,513,960

[1] *Value f.o.b.* [2] *Export values.*

Coal

The record production of coal in India was 22,628,037 tons in 1919. Up to that year there had been a steady annual increase since 1882, when the output was only about 1,130,000 tons. Since 1919 there has been some decline in output, but it amounted to 21,174,284 tons in 1924, and 20,904,377 tons in 1925. India is the second largest producer of coal in the Empire. The position of the Indian coal trade bears some resemblance to that of the United Kingdom in that the productive capacity of the mines is now considerably in excess of requirements both for internal use and for export. Owing to various factors, the quantity exported fell from 757,486 tons in 1913 to 74,335 tons in 1918, and, although this trade is recovering, only 205,518 tons were exported in 1924 and 215,532 tons in 1925. The growth of manufacturing industries, together with recovery in the export trade, is bound to rectify the position in the near future. The Indian Coal Committee reported on the position in 1925, the most important recommendations being those devised to secure guaranteed standards of coal for export.

The principal coalfields of India occur in the Gondwana System, from which about 98 per cent. of the output is obtained. Tertiary coal occurs almost throughout Extra-Peninsular India, and is mined in Baluchistan, Assam, Rajputana, and the Salt Range of the Punjab. The chief Gondwana coalfields are Jharia, in Bihar and Orissa, producing more than half the total output, and Raniganj, partly in Bengal and partly in Bihar and Orissa, producing more than 5 million tons per annum. The Bokaro field, likely to be more important in future, has an output of over 1 million tons per annum, while the Giridih field produces about ¾ million tons. Both of these fields are in Bihar and Orissa. The Ramgarh and Karanpura fields, in the Hazaribagh district, and the Talchir field, in Orissa, are at present under rapid development and have large reserves of coal. Other important Gondwana coalfields are worked in the Central Provinces and the Native State of Hyderabad.

The reserves of coal in India are very large, not less than 54,000 million tons being known, and there is a

possibility that these reserves will be extended by further discoveries. Large areas known to contain coal are still undeveloped, and there is a chance that coal beds will be found ultimately below the Deccan Trap in the Bombay Presidency. Most of the coal at present being worked is at considerable distances from Bombay, and costs about Rs. 24/- a ton for freight from the Bengal fields. The advantages to be derived by Bombay from a nearer supply would therefore be considerable, though it would be largely at the expense of present producing sources. A discussion of this question by C. S. Fox has been published recently in *Rec. Geol. Surv. India* (1925, **58**, Pt. 2). Recent developments in the Bokaro field, lying west of Jharia, have proved large quantities of coal, the main seam at the Jerandih colliery consisting of 126 ft. of clean coal, lying within 450 to 1,800 ft. of the surface. These developments are the more important as much of the Bokaro coal has good coking qualities, in which most of the Indian coals are deficient. On this account a large number of tests have been made by the Government of India, in the laboratory of the Geological Survey, with a view to treating second-class coking coals by froth flotation and so obtaining a high-grade coke from the cleaned product. W. Randall has described these trials in the *Records* (1924, **56**, pt. 3). The expansion of the metallurgical industries in India has led to a greatly increased production of by-product coke. The producing capacity of by-product ovens now amounts to well over 1 million tons per annum as compared with only 200,000 tons in 1918.

Petroleum and Allied Products

India ranks about ninth among the world's producers of petroleum, the output being 1,182,067 tons in 1925, which is about 66,000 tons less than the record attained in 1919. Most of the production is from the old-established fields at Yenangyaung and Singu, in Burma, but the Digboi and Badarpur fields, in Assam, as well as the Attock field, in the Punjab, and several smaller fields in Burma, also contribute. The Burma fields appear to have passed their peak, but the Digboi field has recently shown

more favourable developments. Recent developments in the Attock field have been encouraging, new oil-sands being reported as having been encountered at depth. Active drilling is in progress, and its possibilities are by no means yet exhausted. Deep drilling has been in progress at Dhulian, but has been temporarily suspended in order to drill for increased production from the Khaur field. Further exploratory work elsewhere in the Punjab has not given satisfactory results.

In Burma, at Yenangyaung, more oil is being obtained from the shallower sands, which were neglected during a period of intensive competitive drilling to the lower horizons.

The Indian crude oil is generally of high grade, rich in light oils and paraffin wax, considerable quantities of the latter being exported.

In the Moulmein district of Lower Burma, large deposits of oil-shale exist. The shale contains from 25 to 40 gallons of crude oil per ton, but hitherto only experimental work has been done on it.

All the Indian oil is refined in India, there being several refineries at Rangoon and one at Rawalpindi.

The petroleum occurrences of India have been described in detail by E. H. Pascoe in a *Memoir* of the Geological Survey (**40**: Pt. I, 1912, Burma; Pt. II, 1914, Assam and Bengal; Pt. III, 1920, Punjab and North-West Frontier).

Manganese

As already stated, India is at present the chief producer of manganese ore. Until recently the output has all been exported as ore, but some is now utilised in the domestic market, and 2,258 tons of ferro-manganese were exported in 1925. The production of manganese ore in 1925 was 839,461 tons, valued at £2,617,220, of which 604,198 tons were exported from British Indian ports.

The first deposits of manganese ore worked in India were those of Madras, but the principal sources of production, in order of importance in 1925, were Central Provinces, Madras, Bombay, Bihar and Orissa and Mysore. Of these, the Central Provinces produced about

74 per cent. of the total, chiefly from the Balaghat and Nagpur districts.

Indian manganese ore is obtained largely in hard lumps, a form particularly suitable for blast furnaces, and is favoured on this account over its chief competitor, the Caucasian product. In fact it is often mixed with Caucasian ore by manufacturers of ferro-manganese, partly on account of its physical condition and partly to get a suitable percentage of iron in the furnace mixture. In 1925, 34,843 tons of manganese ore were consumed in Indian iron and steel works in ordinary smelting and in manufacture of ferro-manganese.

Three types of manganese-ore deposits are recognised in India: (1) the gondite group, (2) the kodurite group and (3) the lateritoid group. Ores of the kodurite type have so far only been found in Madras, but the other types are represented in all the provinces above mentioned. Detailed descriptions of the manganese ore deposits of India will be found in the memoir by L. L. Fermor (*Mem. Geol. Surv., India*, 1909, **37**, in 4 parts). Typical gondite ores of the Balaghat and Nagpur districts consist of mixtures of braunite and psilomelane. They occur in lenticular masses, and result from extensive alteration of manganiferous sediments, with concentration of manganese oxides along lines of folding. The extent to which these deposits continue in depth is not yet known, as the abundance of easily worked ore has made exploration of little urgency. The mode of occurrence, however, leads to the belief that these masses may occur at considerably greater depth than the 400 ft. already known in some cases. At the Balaghat (Bharweli) mine, from which nearly 1½ million tons of ore have been mined, the manganese ore bed has been proved for a length of 10,000 ft., and has been worked open-cut to a depth of 180 ft. The width of the ore-body varies from 10 to 60 ft. It is now being prepared for underground working.

In the Vizagapatam district of Madras, bodies of the kodurite type of manganese ore occur, consisting chiefly of psilomelane with small amounts of pyrolusite and braunite. In some cases the ore-bodies have a definite dip and strike, but generally they are of very irregular

outline. The largest mass, at Garbham, is 1,600 ft. long and 167 ft. thick at the widest part. Over 800,000 tons of ore had been won from this deposit up to the end of 1923.

The third class of deposit, known as the lateritoid group, has been formed by surface alteration of rocks of Dharwar age. The masses of ore thus formed vary from iron ores to manganese ores, and selective mining and grading are necessary. Usually the ores of this type are second or third grade, characterized by high contents of iron and phosphorus. The chief lateritic deposits are in the Sandur Hills in Madras and at Kumsi in Mysore.

The reserves of manganese ore in India are undoubtedly very great, but until the more easily accessible ore has been depleted and thorough exploration has been made, it seems unlikely that any reliable estimate of quantity will be possible.

Gold

In 1924, the value of gold produced in India was £1,827,433, of which 99 per cent. was from the Kolar district of Mysore. Small quantities of gold were produced in Burma, Punjab and United Provinces from alluvial sources, and 3,646 oz. in the Anantapur district of Madras, but the Kolar mines are the only serious contributors to the Indian output at present. In 1925, the total production was 393,875 oz., valued at £1,673,501.

Recently, a discovery has been reported of deposits of copper ore, containing up to 2 oz. of gold per ton, in the Narnaul district of the Native State of Patiala, Punjab. The gold-bearing area is stated to extend for a distance of 12 to 16 miles, but results of development work are not yet available.

Alluvial gold has been won from many Indian rivers and is still obtained in small quantities by native workers in Burma, Central Provinces, Punjab and Kashmir. At one time five dredges were at work in the upper reaches of the Irrawaddy, but operations were unprofitable and ceased.

The Kolar goldfield is exploited by five principal companies, and contains some of the deepest mines in the world, shafts at the Ooregaum and Champion Reef mines having reached a depth of over 6,000 ft. from the surface.

The ore is very amenable to treatment, and the chief difficulties on the field are connected with ventilation and support of the workings, owing to the high temperature and liability to rockbursts.

All the mines work the same vein, the Champion lode, which averages about 4 ft. in thickness, and contains payable ore-shoots over a distance of about 4 miles only. It occurs in a band of schistose rocks of Dharwar age lying on granite-gneiss. These rocks contain all the known deposits of gold in southern India. At the end of 1925, the total ore-reserves of the field were 1,541,776 tons. This was a small decrease from the previous year, but favourable developments at the lowest levels of several of the mines give promise of future increase.

It is difficult to believe that the small area comprising the Kolar field can be the only district in India to contain payable gold deposits, more especially as the distribution of gold in India is extremely wide, as shown by the auriferous sands of many of the rivers.

Silver, Lead and Zinc

Practically all the silver, lead and zinc produced in India is from the Bawdwin mine in the Southern Shan States of Upper Burma. Small quantities of lead ore were obtained formerly from the Drug district of the Central Provinces, from Chitaldrug in Mysore and from Kashmir, while silver is obtained as a by-product of gold-mining in Mysore and Madras, amounting to between 20 and 30 thousand ounces per annum.

The Bawdwin deposit of lead ore is one of the largest in the world, and is comparable with the deposit at Broken Hill in New South Wales. On June 30, 1925, the ore reserves totalled 4,370,073 tons, containing 22·2 oz. of silver per ton, 24·9 per cent. of lead, 16·4 per cent. of zinc and 1·3 per cent. of copper. The output of the mine and smelter for the year to the above date was :

Ore mined	289,006 tons
Refined lead . . .	48,514 ,,
Silver	5,049,328 oz. fine
Antimonial lead . . .	2,000 tons
Zinc concentrates .	17,332 ,,
Copper matte . . .	5,206 ,,

The zinc concentrates assayed 12·72 oz. of silver per ton, 7·93 per cent. of lead and 44·37 per cent. of zinc. This material is shipped to European smelters. During the year 16,140 tons containing 45 per cent. of zinc were shipped from the mine.

The deposits, which were worked extensively by Chinese for hundreds of years, occur in a crushed zone of rhyolitic tuffs, which have been replaced by the ore minerals to form very large ore-bodies. The principal ore-body, the Chinaman, has been developed over a length of more than 1,000 ft., and averages about 50 ft. in width. Developments are very favourable at the lowest point yet reached, which is only about 250 ft. below adit level, and the reserves above mentioned are likely to be considerably added to in the future. The scale of operations has increased constantly and rapidly since 1918, when the ore mined amounted to 63,629 tons only. The establishment of this huge enterprise in the heart of the jungle, 600 miles inland from a port, is one of the most remarkable developments in the mining industry of India. These deposits have been fully described by J. Coggin Brown (*Rec. Geol. Surv. India*, 1917, **48**).

A considerable amount of exploration work has been in progress for several years in the Heho district, in the Southern Shan States, and small quantities of lead ore and slags from abandoned native smelting operations have been shipped. The lead ore occurs disseminated in limestone, but no important bodies of ore have been encountered hitherto.

Other silver-lead ore occurrences are on record from many localities in Assam, Baluchistan, Bihar and Orissa, Bombay, Burma, Central India, Madras, Mysore, Punjab, Rajputana and United Provinces, where primitive smelting operations have been carried on in many cases.

Zinc mines in the Udaipur State of Rajputana appear to have been of considerable local importance at one time. The ore was smelted in small bottle-shaped retorts, the metal being condensed in the necks.

The question of zinc-smelting in India has received much attention of late, and plans were adopted in 1920 for the smelting of 25,000 tons per annum of Bawdwin con-

centrates at Jamshedpur, on a site adjoining the steel works of the Tata Iron and Steel Co., Ltd. Sulphuric acid was also to be made, but the project has been abandoned for the present. In 1924, the cost of marketing zinc concentrates in Europe from the Bawdwin mine amounted to Rs. 100/- per ton.

BUILDING MATERIALS

India is very rich in all kinds of building materials, including ornamental stones.

The value of the recorded production of building materials in India in 1925 was £853,851, which compares with £733,117 in 1924. These figures are incomplete, however, and no doubt the full value is much more.

The principal items of the output recorded in 1925 were as follows:

Material.	Long tons.	£	Remarks.
Granite and gneiss	524,982	76,375	Burma, £73,327
Laterite	283,974	25,730	Burma, £20,155
Lime	13,425	13,193	Central India, £12,453
Limestone and kankar[1]	3,108,710	381,317	Bihar and Orissa, £163,095
Marble	5,651	14,767	Rajputana only
Sandstone	310,943	80,677	Rajputana, £60,224
Slate	25,027	13,756	Punjab, £10,357
Trap	23,093	3,457	Bihar and Orissa, £3,277
Miscellaneous	2,334,401	244,579	United Provinces, £79,046

[1] *Including* 316,580 *tons of dolomite in Gangpur State for use as flux in iron and steel industry.*

The varieties of materials that come under this heading are too numerous for detailed description, but it may be stated generally that each of the three main physical divisions of India has its own characteristic materials. Peninsular India makes large use of igneous rocks, such as those of the Charnockite Series of Madras and the gneissose granites of North Arcot and Mysore, as well as slates and limestones of the Cuddapah Series and basalt from the Deccan Trap. In Central India, excellent sandstones and limestones of the Vindhyan System are available, while Gondwana sandstones are used in the neighbourhoods of the coal-fields. Nummulitic limestones are largely quarried in Assam and the North-West, while foraminiferal Porbandar stone from Kathiawar is used

extensively in Bombay and Karachi. The prevalence of tropical conditions has resulted in the formation of two of the most important building materials used in India, namely laterite and kankar. Laterite is widely distributed in the Peninsula and Burma, and over 270,000 tons were quarried in Burma and Madras in 1925. Its property of easy working when freshly quarried, and of hardening when exposed to the atmosphere, makes it particularly suitable for buildings, etc. Kankar, a concretionary form of carbonate of lime, occurs in alluvial deposits. It has the composition of an hydraulic lime when burnt, and is used extensively for road-making, only the more massive deposits being suitable for building stone.

At present, considerable quantities of granite and marble are imported into India, many of the native deposits being distant from water transport, and consequently expensive to work on the scale necessitated by current requirements.

The manufacture of cement in India is increasing rapidly, and a number of new plants have been put into operation in recent years.

SALT

India produces nearly as much salt as the United Kingdom, the output in 1925 being 1,295,144 tons, of which 150,380 tons was rock salt and the balance sea salt and salt from natural brines. The total also includes 188,493 tons of sea salt manufactured at Aden. A considerable increase in the average output has been shown in each of the last three quinquennial returns. Although the production is so large, imports of salt are also very considerable, 541,141 tons being imported in 1925. The imported salt consists largely of more refined qualities, the average value per ton of the imported salt being about three times that of the domestic product. The manufacture of salt in India is subject to licence and there is an excise duty of Rs. 2½ per maund (82 lb.), equivalent to about ½*d.* per lb. A considerable quantity is made under direct Government control.

About 60 per cent. of the total output is made from sea water, chiefly in Bombay, Madras and Aden ; about 30 per

cent. from sub-soil and lake brines and saline earth, principally in Rajputana; while the remaining 10 per cent. is obtained as rock salt from the Salt Range of the Punjab and from the North-West Frontier Province.

In Bombay, where 381,419 tons of salt were produced in 1925, a large proportion of the output is made on the edge of the Lesser Rann of Cutch, at Kharagoda and Udu, where large Government works are situated. A plant for the recovery of magnesium chloride from bitterns and for the manufacture of refined table-salt was established during the war at Kharagoda, and an output of about 8,000 tons of magnesium chloride was sold, but the operations do not appear to have been remunerative.

In Madras, practically all the salt production is from numerous evaporating areas along the coast. A separate Salt Department, formed in 1924, is endeavouring to concentrate the work in fewer but larger and more effective units. This province produced 336,605 tons in 1925.

The whole of Rajputana appears to be impregnated with salt, from the coast of Cutch and Sind north and north-eastwards to the borders of the Delhi district and Bahawalpur State. It is considered that this salt has been carried by the winds in a finely divided state from the salt-incrusted Rann of Cutch and has become fixed by ensuing rains which have re-concentrated it in small lakes, in areas of internal drainage. The largest of these lakes, Sambhar, has an area of 90 sq. miles at its highest level, but dwindles to a small pond by the end of the dry season. It is calculated that the salt stored in the bed of this lake to a depth of 12 ft. is not less than 54 million tons. About 230.000 tons of salt is produced annually.

The Salt Range produces 85 per cent. of the Indian rock salt, chiefly from the Mayo mines near Khewra, the Warcha mines in the Sharpur district and at Kalabagh on the right bank of the Indus. These rock-salt deposits are enormous and practically inexhaustible at the present rate of extraction. They appear to belong to one great salt formation extending from Khewra in the Punjab westwards to Bahadur Khel on the N.W. Frontier, interrupted only by the valley of the Indus.

MICA

Indian mica is of the highest quality and India is the world's chief producer of sheet mica both in regard to quantity and value. The exports in 1925 amounted to 99,699 cwt., valued at £799,483, as compared with 70,095 cwt., valued at £679,796 in 1924. The average price was £8·0 per cwt. in 1925 as against £9·7 per cwt. in the previous year. The production figures are incomplete, but show that Bihar and Orissa is the chief producer, followed by Madras with a considerable output, and by Rajputana, Mysore and Gwalior with comparatively unimportant quantities.

Some phlogopite mica has been obtained in Travancore, but nearly all the Indian mica marketed is muscovite. It occurs as "books" in pegmatite veins that traverse schists and gneisses. The Bihar mica belt, extending for about 60 miles in length and 12 miles in width through the Monghyr, Hazaribagh and Gaya districts of Bihar and Orissa, is the chief producer, especially that part of it in the Hazaribagh district, while a similar belt of equal length in the Nellore district of Madras is of considerable importance. The sporadic nature of the occurrence of mica "books" in the pegmatites makes it impossible to estimate reserves, but there is no doubt that these are very great.

Recently, more modern methods have been adopted in some localities, but many workings are still very primitive in character. In Hazaribagh, mining is usually by means of underground burrowings following on from one "book" to the next; in the Nellore district open quarries are more usual. Mica from the Bihar belt is generally of a ruby colour, while that of Madras is characteristically of a green colour.

The preparation of mica for the market requires great skill, and can be done in India more efficiently and more cheaply than elsewhere. In fact, a certain amount of mica is imported into India in block form to be prepared and re-exported as splittings, etc. The loss in mining and preparing mica for the market is very great. According to C. S. Fox less than 1 per cent. of the rock excavated is obtained as marketable mica. In the dressing of block mica there is a heavy loss, and there are large accumulations

of waste mica that might be used for the manufacture of micanite, and possibly in other ways. Some attempts have been made already in this direction, but apparently without much success, and there would appear to be considerable economic advantage to be gained by the industry in the establishment of works for the utilisation of what is at present a waste product.

Iron and Steel

The production of iron ore in India, in 1925, was 1,544,578 tons, an increase of 99,265 tons over the previous year. In 1910, the quantity was only 54,588 tons ; but since then new smelting works have been established, and a constant increase in ore production has been necessitated.

Nearly all the ore is smelted in large modern blast furnaces, but even in 1925 there were 211 native furnaces at work in the Central Provinces, apart from an unknown number in other parts of India. The total annual output of the native furnaces, however, is estimated at not more than about 1,000 tons of iron.

India's resources of high-grade iron ore are very great, the deposits of the iron-ore belt running through Bihar and Orissa and Central Provinces being estimated to contain 20,000 million tons within a maximum distance of 500 miles from fuel and an average distance of 125 miles. According to C. S. Fox, the hæmatite ores of Singhbhum and Orissa exceed both in quality and quantity any other occurrence of the kind, including the Lake Superior ores of the United States. They lie within 150 miles of the coalfields supplying coking coal, and amount to 2,832 million tons, averaging between 60 and 68 per cent. of iron, 0·08 of phosphorus, and 0·6 of sulphur. In addition to this quantity of high-grade ore, very large quantities of lower-grade hæmatite ores exist in the same belt, all being in rocks of Dharwar age. Of several important deposits of iron ore in Mysore, the most important are those of the Bababudan Hills, where over 30 million tons of ore averaging 60 per cent. of iron are estimated to exist. The Mysore Government has erected large blast furnaces for production of charcoal pig-iron from these deposits, the charcoal being made from the timber of the Shimoga

Forest. In the Chanda district of the Central Provinces a hill of hæmatite supplied ore for early but unsuccessful efforts at blast-furnace smelting. It is estimated that this district has over 100 million tons of ore containing 61 to 67 per cent. of iron. In the Drug district (Central Provinces) the Rajhara Hill deposit has proved reserves estimated at 6 to 10 million tons of hæmatite, containing 66 per cent. of iron, 0·058 of phosphorus and 0·108 of sulphur.

In the Salem, Nellore, Nilgiri and Padukotai districts of Madras enormous quantities of magnetite ores occur, the estimates running into thousands of millions of tons. The best ores are thought to be those of Kanjamalai, where an average analysis of ore shows about 55 per cent. of iron, 0·3 to 0·6 of phosphoric acid and 0·08 of sulphur. The difficulty with regard to working these deposits is their great distance from fuel.

Lateritic ores are very widespread in Central India. They vary considerably in composition, ranging from 30 per cent. of iron over large areas between the Rajmahal hills and the Bombay coast, to over 50 per cent. of iron in various deposits in the Jubbulpore district of the Central Provinces. Fermor estimates that the amount of ore available in the Kankwara Hills of this district is 49 million tons, containing 57½ per cent. of iron with 0·76 per cent. of phosphorus.

Clay-ironstones are associated with the coals of the Gondwana System, the best known being in the Damuda beds of the Raniganj coalfield. The reserves of this ironstone have been variously estimated, but may be taken to be not less than 400 million tons, containing 38 to 46 per cent. of iron. Until 1913, this class of ore was used in the Barakar Iron Works at Kulti, but a change was then made to the richer hæmatite ores of Kolhan near Manharpur.

It is evident, therefore, that the supplies of iron ore are sufficient for the establishment of a great iron and steel industry in India. The only limiting factor in sight that may influence the growth of the industry, which is already established, is the quantity of available coal of a character suitable for the provision of metallurgical coke. This question has been the subject of considerable discussion, which has led to a special investigation and re-survey of

the coalfields now being made by the Geological Survey of India. An interesting discussion of the position took place recently on a paper by C. S. Fox, "The Raw Materials for the Iron and Steel Industry of India" (*Trans. Min. Geol. Inst.*, 1925, **20**, pts. 1 and 4). The present known supplies of coking coal are estimated by various authorities as sufficient for the next 30 to 200 years at the present rate of consumption, plus allowance for expansion. They are far short, however, of the quantity required to deal with the known reserves of iron ore.

Three large smelting plants are already operating in India, while one other is under construction and several more in contemplation. It is estimated that by 1928 the total annual output of pig-iron in India will be about 1,500,000 tons, for which about 2,650,000 tons of iron ore will be required. The outputs at Jamshedpur in 1925 of the largest company now operating, the Tata Iron and Steel Co. Ltd., were 563,160 tons of pig-iron, 309,938 tons of steel, and 6,527 tons of ferro-manganese. In a normal year the output of pig-iron at these works should be about 600,000 tons. The Bengal Iron Co. Ltd., produced 52,674 tons of pig-iron at Kulti; the Indian Iron and Steel Co. Ltd., produced 247,500 tons at Asansol; and the Mysore Government works at Bhadravati produced 16,741 tons. Thus the total production of pig-iron in 1925 was 880,075 tons, which compares with 872,547 tons in 1924. As the pig-iron production of the above works largely exceeds their steel-producing capacity, together with the country's requirements of iron for casting, an export market is necessary for the surplus of pig-iron. In the year ending March 31, 1926, India exported 381,989 tons of pig-iron, an increase of 40,000 tons over the previous twelve months. In the same period 1,583 tons of ferro-manganese were exported. Thus India has already become an important exporter of pig-iron, the exports in 1925 being exceeded only by those of the United Kingdom and France. Although pig-iron can be produced very cheaply in India, it has been found necessary to protect the steel industry, and a bounty has been granted on production of steel ingots as well as increased protective duties on various classes of fabricated steel.

The Tata Company produces practically the whole output of steel in India, its output of finished steel products during 1925 being as follows:

	Tons.
Rails (light, medium and heavy)	118,600
Fishplates	4,700
Steel trough sleepers	1,600
Beams, channels, angles and tees	45,100
Bars	52,300
Tinplate bars	35,100
Sheets (black)	15,000
Sheets (galvanised)	10,700
Total	283,100

In the year ending March 31, 1926, the production of this Company was:

	Tons.
Pig-iron	573,000
Steel ingots	470,000
Finished steel	320,000

TIN

The only Indian deposits of tin ore that are of economic importance occur in five districts of Burma. In 1925, the production of concentrate amounted to 2,308 tons, valued at £267,931. This was an increase of 428 tons over 1924, and, as prospecting has been very active during the past two years and new deposits are being prepared for production, a considerable increase may be confidently expected in the future.

In 1925, the Tavoy, Mergui, Thaton and Amherst districts were the producing areas. There was no production in the Southern Shan States in that year, but the deposits at Mawchi are now being worked again, and may be expected to contribute appreciably to the total.

All the Burmese tin deposits are connected with granite intrusions that are a continuation of the granite ranges of Malaya and western Siam. Almost invariably cassiterite and wolframite occur together, the proportions varying widely. As a general rule the proportion of wolframite in the vein deposits increases as the deposit is farther north of Malaya. In the alluvial deposits, however, wolframite is usually absent. During the war, the vein deposits were worked intensively as a source of tungsten, but they are

now being worked chiefly for tin, the wolframite being obtained as a by-product.

In the Tavoy and Mergui districts the veins of cassiterite and wolframite occur in granite, in schists closely associated with the granite and in stringers in pegmatite veins. Most of the concentrate won hitherto in Mergui has been from alluvial and detrital deposits derived from the foregoing, and a dredge is now being installed on one property and other dredging propositions are likely to be developed. In Tavoy, wolframite predominates in the veins, but there are many promising hydraulicking tin propositions and dredging has been carried on very successfully for many years in the valley of the Hindu Chaung. A dredge is to be installed to work the coastal deposits in the Heinze Basin and other interesting ventures are projected. In fact, the tin resources of these two districts are now in process of thorough investigation, and considerable expansion in output may be anticipated.

The Thaton and Amherst districts have produced only a small amount of tin concentrate in recent years. In both districts the deposits are alluvial, the cassiterite being derived from granite rocks.

In the Southern Shan States practically the only producer is the Mawchi mine, where at least ten veins containing about 2½ per cent. each of cassiterite and wolframite are being developed and worked. In 1920, this mine produced 1,030 tons of mixed concentrate. In September, 1926, the output was 136 tons.

Saltpetre

India is the only country producing natural potassium nitrate in quantity. In 1925, the exports were 6,349 tons, valued at £147,617. Production figures are not now available, but the average annual production for the five years 1919 to 1923 was 14,542 tons.

Indian saltpetre can hardly be considered a mineral product. It is the result of ideal climatic conditions, acting in a densely populated agricultural area where potash and nitrogenous organic matter are abundant in the soil. The area chiefly concerned is the Bihar section

of the Gangetic plain, where the population is over 500 per square mile, and the climate favours the growth of nitrifying organisms.

The potassium nitrate appears in the dry season as an efflorescence at the surface of the soil. This is scraped up and the mixture of potassium nitrate and salt dissolved out. The solution is subjected to fractional crystallisation, resulting in the production of a crude saltpetre which is sent to refineries where the final export product is obtained. Until recently most of the output was exported, but there is a growing demand for its domestic use as a fertiliser for tea gardens. The normal consumption for this purpose is estimated at about 1,400 tons per annum.

Copper

The annual output of copper ore in India from 1919 to 1922 was about 30,000 tons, but in 1923 fell to 6,550 tons. This ore was raised at the Rakha mine, in Singhbhum, which, however, closed down in 1923. Thus in 1925 there was no production from Peninsular India. On the other hand Burma contributed 8,029 tons of copper matte, valued at £262,297, from the Bawdwin mine, which also produced 2,935 tons, valued at £114,714, in 1924.

Copper ores are widely distributed in northern India along the outer Himalayas, in Rajputana, Bengal, Bihar and Orissa and Madras. Formerly, the metal was smelted in considerable quantities, and at many localities there are extensive old workings.

In recent years prospecting and development work has been chiefly in the Singhbhum district of Bihar and Orissa, where a copper-bearing belt extends for 80 miles. As mentioned in the section dealing with gold, attention is now being paid also to deposits in the Narnaul district of Patiala, Punjab, where the ores contain values in gold as well as copper.

In Singhbhum, the copper ores occur somewhat irregularly, being interbedded in bands or disseminated in grains, in Dharwar phyllites and schists. At the Rakha mine, Matigara, the Cape Copper Company developed 407,000 short tons (2,000 lb.) of ore averaging 3·8 per cent. of copper, but after treating 130,000 tons for a recovery

of 3,550 tons of copper the Company went into liquidation and operations ceased. At the Mosaboni mines, the Indian Copper Corporation has developed over 470,000 tons of ore averaging about 4 per cent. of copper. Power, concentrating and smelting plants are to be erected near the Subarnarekha River on the Bengal-Nagpur Railway.

In Burma, the only important occurrence of copper ore known at present is at the Bawdwin mine, where the total reserves of ore reported on June 30, 1925, contained an average of 1·3 per cent. of copper, equivalent to 56,800 tons of metal. The copper ore occurs in fairly large but irregular masses in the main ore-body, and is difficult to estimate separately. Recent development has proved increased proportions of copper ore, and it may be possible to define these reserves separately in future.

Sikkim contains many promising bodies of copper ore and a considerable amount of prospecting was done there before the war. Under present conditions, inaccessibility and lack of transport facilities have hindered exploitation, but it is considered that these difficulties might be overcome by aid of hydro-electric installations.

The consumption of copper in India is considerable, and there is a domestic market ready to absorb large quantities of the metal at higher prices than are obtainable in Europe.

Jadeite

Jadeite is a silicate of sodium and aluminium, thus differing from jade, which is a silicate of calcium and magnesium. The Indian trade in jadeite is almost entirely with the Chinese, who value it for its beauty and supposed magical properties. The production is entirely from a remote part of Burma, the basin of the Uru River, a tributary of the Chindwin, in the Mosaung sub-division of the Myitkyina district. In 1925, the production of jadeite was 1,697 cwt., valued at £20,086, as compared with 2,630 cwt., valued at £61,906 in 1924. Owing to the disturbed state of China there has been a considerable fall in production in recent years and stocks have been accumulating.

The workings are in three localities, namely, Mamon,

Hweka, and Tawmaw. At Mamon the jadeite is found as boulders in alluvial deposits; at Hweka it occurs as boulders in a Tertiary conglomerate; and at Tawmaw it is found in a metamorphosed dyke intruded into serpentine.

The jadeite industry is carried on in very primitive fashion, and requires reorganisation if the decline of output during recent years is to be arrested.

Chrome Ore

The production of chrome ore in India, in 1925, was 37,452 tons, valued at £40,171, as compared with 45,462 tons, valued at £42,259, in 1924. The output has fluctuated considerably from year to year, but the average for the last two quinquennial periods has risen from 22,929 tons, in 1914–18, to 35,004 tons in 1919–23.

Baluchistan, Bihar and Orissa, and Mysore are the producing provinces, the first-mentioned being the most important. Most of the Baluchistan output is from the Zhob district and consists of high-grade ore which occurs in segregated masses in serpentine. About 2 miles east of Khanozai, a mass of almost pure ore has been worked for a length of 400 ft. over an average width of 5 ft.

In Mysore, chromite is worked in the Mysore, Hassan and Kadur districts, where it occurs as veins, lenses, and segregated patches in ultra-basic rocks. The most important deposits are in a narrow strip of serpentine, about 2 miles long, near Shinduvalli, a few miles east of Kadkola.

In Bihar and Orissa, narrow bands of chrome ore occur in serpentinised rocks. The production from these hitherto, however, has been small, amounting to 3,038 tons in 1925.

Clay

The Indian returns for production of clay do not include common clay in Madras, United Provinces and other areas, and are, therefore, incomplete. In 1925, the return shows 128,860 tons, valued at £21,795. The material covered by the returns includes river silt and better qualities of common clay, fireclays from the Gondwana coalfields and various grades of pottery clay.

India has enormous resources in common clay, widely distributed, and has also good clays suitable for production of porcelain and high-class pottery. The principal deposits of china clay that have been investigated are in the Jubbulpore district of the Central Provinces and at Mangal Hat in the Rajmahal Hills (Bengal). Both these deposits are now being worked.

Tungsten

India was the world's chief producer of tungsten ores before the war, and reached a maximum production of 4,542 tons of concentrate in 1917. In the following year, a sevenfold increase of output by China, and the complete cessation of demand after the Armistice, resulted in nearly all the mines being closed down. The price of tungsten is still so abnormally low that it no longer pays to work the deposits for their wolframite content, and the output at present is merely a by-product of tin-mining operations. In 1925, the output amounted to 772 tons of concentrate, valued at £33,975, the whole of which was from the Tavoy district.

Tungsten ores occur in the Singhbhum district of Bihar and Orissa, and the Marwar district of Rajputana, but these occurrences are of little importance and produced small quantities only when prices were high during the war. All the important deposits are in Burma and have already been referred to under "Tin."

There are considerable reserves of tungsten ore available in Burma, and no doubt they will be mined when the market recovers. The present price per unit of tungstic oxide contained in the ore is about 14*s*. as compared with about 30*s*. before the war.

Other Minerals

Diamonds have been found in many localities in Madras and Central India, but the production is unimportant, being only 47·63 carats, valued at £1,098, in 1925.

Rubies, sapphires and spinels occur in the Mogok area of Upper Burma, where 109,998, 31,508 and 7,531 carats respectively were won in 1925. The total value of these

stones was £27,454. The Burma Ruby Mines, Ltd., which has been working the deposits for many years, has now gone into liquidation, the best parts of the deposits being exhausted.

Sapphires were worked formerly in a valley near Sumjam in Padar, Kashmir, and some good stones were recovered, but nothing has been done there for 18 years.

Fuller's earth is worked at Katni, in the Jubbulpore district of the Central Provinces. A form of fuller's earth called *Multani matti* is worked in the Bikanir and Jaisalmer States of Rajputana.

Magnesite has been mined for twenty years in the neighbourhood of Salem, in Madras, where the Chalk Hills derive their name from a network of white magnesite veins that occur over an area of about 4½ sq. miles. In 1925, 29,620 tons were produced in this area. Magnesite occurs at several other localities in southern India, and in the Mysore and Hassan districts of Mysore State. Up to 4,000 tons per annum have been produced in Mysore, but there was no output in 1925 owing to the principal mine being temporarily closed down. Calcined magnesia and dead-burnt magnesia are manufactured in the Salem district by one firm, about 6,000 tons of magnesia being produced per annum.

Bauxite, of which mineral India has large resources, is only worked at present on a small scale at Katni, Central Provinces, and in the Kaira and Belgaum districts of the Bombay Presidency. The Katni ore is used for making aluminium sulphate while the Kaira ore is used in the purification of kerosene. The production in 1925 amounted to 10,070 tons, valued at £6,320, of which 1,603 tons was from Katni, 6,967 from Kaira and 1,500 from Belgaum. There are important deposits of bauxite in India which are likely to be exploited eventually on a large scale. At one locality in Kashmir State, there has been discovered recently a deposit estimated to contain not less than 30 million tons. C. S. Fox has dealt with the bauxite deposits of India very fully in *Mem. Geol. Surv. India* (1923, **49**, pt. 1), which should be consulted by those requiring further information.

Monazite.—India is the chief producer of monazite, the deposits being very extensive and sufficient to meet the world's requirements for many years. Recently, the industry has been depressed, the production in 1925 being only 622 tons, valued at £9,301. This was a considerable increase over the previous year, but far below that of 1918, when 2,117 tons, valued at £58,819, were produced. The production of monazite is coupled with that of ilmenite and zircon, which are obtained as separate concentrates in the treatment of monazite sands. In 1925, the output of monazite was 1 cwt., of ilmenite 328 tons, and of zircon 576 tons.

The deposits occur along the coast of Travancore between Muttum and Colachel. They are richest in monazite where concentration by wave-action has taken place, but the dune sands also contain monazite.

In view of the increasing demand for ilmenite for the manufacture of titanium dioxide paints, the outlook for the monazite industry is improving.

Gypsum is produced principally in the Bikanir and Jodhpur states of Rajputana and the Jhelum district of the Punjab. In 1925, the total production was 36,244 tons, valued at £5,810. The mineral is widely distributed in India, but the distance of many of the deposits from a market renders them unpayable at present.

Sillimanite.—Although the use of sillimanite as a refractory is yet only on a very small scale, a great deal of experimental work is being done on it owing to the discovery of the mineral in quantity in the Khasi Hills of Assam. During the war considerable quantities (2,060 tons in 1917) were exported to Europe, but this was for use as an abrasive under the false impression that the material consisted of corundum.

Kyanite was discovered in 1921 in the Singhbhum copper-belt, in masses of various sizes up to hills containing many thousand tons. In 1925, 6,182 tons of kyanite were exported from the Lopso Hill deposit in Kharsawan State (Singhbhum). Kyanite changes to sillimanite at a temperature of 1,300° C. and expands 11 per cent. in volume on heating. For these reasons it is possible that a large demand may arise for kyanite as a refractory material.

Among other minerals should be mentioned *pigment minerals*, including barytes, graphite, ochre and steatite; *abrasives*, including corundum and garnet; and *gem minerals* not already referred to, including garnet, aquamarine, tourmaline and agate.

NOTES

The Platinum Position, with Special Reference to the Transvaal.—There are not yet sufficient data from which to estimate what the world output of platinum, or its price, will be in the near future. Paul Kovaloff, a platinum expert in the Transvaal, recently published an estimate that the world's future annual consumption of platinum would be 225,000 oz. Of this amount Russia would supply 85,000 oz.; Colombia, 38,000; Canada, 15,000; United States, 7,000, and other places 1,000 oz. This would leave about 80,000 oz. for the Transvaal to supply. In the last two years 35 companies have been floated in the Transvaal, with a capitalisation of £6,000,000. (This does not include big financial groups, which generally hold many shares in the various platinum companies proper.) Of the thirty-five companies only eleven, with a capitalisation of £4,000,000, are likely to survive. To pay 10 per cent. on this, £400,000 per year profit would be necessary.

Assuming the average grade of ore to be 5 dwt. of platinum per ton, the total cost of producing 1 oz. of platinum, working on a large scale, has been estimated at about £8. With platinum at £20 per oz. a working profit of £12 is indicated; at £12 an oz., assuming a considerable drop in price, a profit of £4. With a total profit of £400,000 an output of 100,000 oz. at £12 per oz. is indicated, which is 20,000 oz. greater than the 80,000 oz. allotted by Kovaloff to South Africa. The general consensus of opinion in the Transvaal is that eventually 100,000 oz. per annum will be far below the production capacity of the country, and that co-operative restriction of output will be necessary to maintain the price of platinum.

At the present time there are about 600 European and 9,000 native employees engaged by the various Transvaal companies, mostly in prospecting and development work.

Of the eleven companies mentioned above, six have built, or are building, pilot treatment plants. Two of these plants, the Welgevonden and the Onverwacht, have already commenced production.

The Welgevonden plant in the Waterberg district operated for five months only, producing 484 oz. of crude platinum (about 75 per cent. platinum metals) from 4,577 short tons of ore. It was shut down at the end of August as the low milling results did not confirm the estimated development values. The ore treated was peculiar to a small area only, and of a character quite different from that met with elsewhere, so the results do not throw much light on the general position.

The Onverwacht plant in the Lydenburg district is being doubled in capacity. In the first 7½ months of operation, 8,109 short tons of ore were treated for a recovery of 4,377 oz. of crude platinum, containing roughly 75 per cent. of platinum metals. The Mond Nickel Co., Ltd., is refining the products at Swansea. The results from the first lot showed 1,875 oz. of refined platinum, which, after payment of all charges beyond the mine, yielded £35,186, or £18 15*s.* 4*d.* per oz. On the mine, 3 months' working costs of £10,111 corresponded to a yield of 1,907 oz. of crude platinum, or, say, 1,430 oz. of fine platinum. This is equivalent to £7 1*s.* 6*d.* per oz.; thus a working profit of over £11 per oz. is indicated with small-scale working on the grade and class of ore treated. A 10 per cent. dividend was paid after 6 months' independent working.

The grade of the Onverwacht ore is probably double that of the average ore which will be ultimately treated in the Transvaal, so that the profits per oz. on the same tonnage of the lower-grade ore treated would be reduced, whilst large-scale operation would increase them again. The platinum position in the Transvaal should be much better known about 6 months hence, when results have been obtained from the other four pilot plants.

Canada's Mineral Output for first half of 1926.—According to information received by the High Commissioner for Canada from the Dominion Bureau of Statistics, Ottawa, Canada's mineral output during the first half of 1926 was valued at \$98,395,788, of which \$61,249,482 represented metals and \$37,146,306 non-metallic minerals. This is an increase in value of \$8,048,090 over the output for the corresponding period in 1925, the increase for metals being about two million dollars, while that for non-metals was about six million dollars. Of the total value mentioned above, coal, gold, lead, copper, nickel, silver, zinc, asbestos, natural gas and gypsum represent an aggregate value of \$94,523,857, or 96 per cent. of the total.

Some of the more notable items are as follows :

Mineral Production of Canada

Mineral.	Unit.	First Half of 1926.	First Half of 1925.
Metallic :			
Arsenic	Lb.	2,287,801	2,116,141
Cobalt	,,	384,034	590,087
Copper	,,	70,843,426	53,055,349
Gold	Fine oz.	885,813	824,043
Lead	Lb.	138,397,755	128,398,836
Molybdenite	,,	3,530	—
Nickel	,,	34,519,896	35,756,640
Palladium, etc.	Fine oz	5,088	
Platinum	,,	5,166	
Silver	,,	11,108,310	9,240,482
Zinc	Lb.	67,159,570	45,257,772
Non-metallic :			
Asbestos	Short ton	132,644	120,800
Coal	,,	6,895,813	5,383,714
Felspar	,,	13,135	13,421
Graphite	,,	1,371	1,077
Gypsum	,,	250,369	234,705
Magnesite	,,	2,498	1,785
Mica	,,	1,148	1,370
Natural Gas	M. cu. ft.	10,010,079	8,331,104
Petroleum	Barrel	173,880	80,970
Pyrites	Short ton	7,615	1,666
Quartz	,,	62,314	69,792
Salt	,,	124,921	105,770
Sodium carbonate	,,	326	557
Sodium sulphate	,,	2,221	1,916
Talc	,,	7,888	7,056

Of the more important increases in metal output it is noteworthy that copper advanced nearly 18 million pounds in quantity and 2·4 million dollars in value as compared with the first half of 1925. Gold increased by 61,770 oz., or 1·3 million dollars; silver, 1·86 million oz., or 1·03 million dollars; lead by about 10 million pounds in quantity and zinc by 12 million pounds in quantity.

As regards the non-metallic group, the outstanding increases were those of asbestos, petroleum and natural gas. Salt and gypsum also showed increases and higher values were realised for graphite.

The Mineral Belt of North-West Quebec.—The numerous discoveries of deposits of gold, copper, zinc and other ores which have been made recently in the Rouyn and neighbouring township of north-west Quebec have attracted much attention to the district, which, it is considered, may eventually prove the fifth most important mineral area in Canada.

The belt containing the Kirkland Lake and Larder Lake deposits of north-east Ontario extends a distance of about 60 miles from Matachewan on the west to Larder Lake on the east, near the Quebec boundary. For many years

cent. after the development of the gold and silver deposits of Ontario near the boundary there was speculation about the existence of similar deposits further east in Quebec. Some prospecting was carried out, but there were no positive results. More recently the Transcontinental Railway to the north has been finished, and along it in Quebec there have already been settled over 17,000 agricultural people, to whom the local development of a large mining industry, and a consequent market for their produce, would be beneficial.

In 1922, two discoveries of gold were made simultaneously in Rouyn township, and in consequence a large number of prospectors flocked into the locality. A considerable area was staked out in the township, and renewed interest was taken in properties previously abandoned in Dubuisson and Boischatel townships to the west, in the latter of which was the old Fortune mine, near to and east of Lake Fortune.

The Geological Survey of Canada, foreseeing the possible extension of prospecting from Ontario into Quebec, began in 1922 a detailed mapping of a strip of territory about 35 miles wide from north to south, extending on its south side from Larder Lake to the Bell River on the east in Quebec. The mapping of part of an area some 50 miles long and extending to the west end of Kewagama Lake in La Pause township has been finished recently. The Department of Mines of Quebec also has done much geological work in the area, and in its *Report on Mining Operations in the Province of Quebec*, 1924, is given a general description of the geology of the Abitibi and Timiskaming counties, as well as a list of publications on the geology of the area.

Notwithstanding the large number of discoveries that have been made, development has been seriously delayed, except in a few cases, largely, perhaps, owing to the wide area covered and the consequent diffusion of effort, but mainly to an almost complete absence for some time of transport facilities. An air service from Angliers on the Canadian Pacific Railway was begun in July, 1924, and some roads were cut. In November, 1925, an extension of the Timiskaming Railway was made to the Ontario boundary. Recently another railway, 45 miles long, from O'Brien to Rouyn City has been completed. This railway will much reduce transportation costs and enable heavy machinery to be brought into the district.

The settlement of the railway position has resulted in the attraction of much capital, and a waiting policy is being replaced by preparations for active development generally. Already the Noranda Mines, Ltd., hitherto

mainly concerned in the development of the Horne Mine, has made arrangements for the erection by 1928 of a 1000-ton unit of a 3,000-ton-a-day smelter, to cost $4,000,000, and for the laying out of a town to accommodate 15,000 people, to be known as Noranda. The addition of a second 1,000-ton unit in the near future is contemplated. To bring electric power into the district a transmission line is being brought from the Des Quinze power plant of the Canadian National Power Company.

These projects alone show what an extensive development has taken place in a very short time. Altogether about eighty properties in the district are either being developed or prospected. The most important of them so far known are the Horne, the Waite-Montgomery, the Alderson-McKay or Towagmac and the Amulet. Amongst the others with great prospects are the Arntfield, the Chance, the Holliwell, the McDougall-Cassells, the Coniagas and Nipissing.

The Horne, with reserves valued at $35,000,000, has ores containing 4 to 15 per cent. of copper and gold averaging $5·45 per ton in value, the latter being sufficient to pay all working expenses. The Waite-Montgomery, with reserves valued at $11,000,000, has ores containing an average of 17 per cent. of copper and 3½ per cent. of zinc. The Amulet has copper-zinc ore valued at $3,000,000. On the Towagmac mine $4,500,000 worth of ore is indicated. Prospecting has been aided by electrical methods and by diamond-drilling. The first unit of the smelter, according to estimates, will be treating a $30 ore, and will be making a profit of $6,000,000 a year.

Mineral Production in British Guiana.—According to the Report of the Lands and Mines Department for British Guiana for 1925, the outputs of minerals during that year included 9,107 oz. of gold and 182,895 carats of diamond, while the exports of selected bauxite amounted to 174,999 tons.

The largest gold-producing area is the Essequibo-Konawaruk-Potaro district, with a total output for the year of 7,736 oz., the next most productive area being the Barima district in the north-west, with a total output of 820 oz. Of the total gold output, 6,787 oz. was won by dredging, an increase of 1,495 oz. on the dredging output of the previous year.

The diamond output showed a decrease of 2,690 carats as compared with 1924. The outputs in carats of the different producing districts were: Mazaruni, 149,249; Puruni, 7,399; Cuyuni, 1,025; Potaro, 24,110; Berbice,

1,112. The average weight of the stones produced was 6·3 carats.

Mining operations for bauxite were continued throughout the year at Akyma and Coomacka, on the Demerara River, the selected ore being crushed and dried before it was exported. The crushing and drying are carried out lower down the river at Mackenzie, this being the highest point to which ocean-going vessels can proceed. Excepting 4,976 tons shipped to the United Kingdom, all the ore was exported to the United States, pending the completing of works in Canada. The average value was $5·06 per ton, f.o.b. Mackenzie.

A geological and mineralogical reconnaissance survey was commenced during the year in the Upper Mazaruni district, and a preliminary survey of the geology and economic resources of the Mazaruni and Puruni diamond fields was carried out. As a result of this survey it was inferred that the important economic mineral possibilities of the Colony, other than bauxite, relate to gold, diamonds, and other precious stones, manganese, iron, the pegmatite minerals, platinum metals, mica, mercury and graphite. It is considered improbable that any important gold deposits will be discovered in the area of the diamond workings ; and it is stated that no discovery of platinum metals has been made in these alluvial deposits up to the present.

For further details relating to the results of this preliminary survey, reference should be made to the *Report of the Preliminary Survey of the Mazaruni and Puruni Diamond Fields, British Guiana, March-December,* 1925, by H. J. C. Conolly (Published by the Crown Agents for the Colonies, 4 Millbank, London, S.W.1).

The Mineral Industry of Trinidad.—The Administration Report of the Inspector of Mines for the year 1925 again shows a considerable increase in the production of crude oil, another record output having been obtained, amounting to 4,386,507 barrels. Exports of petroleum products showed a corresponding increase and constituted over one-third in value of the total exports of the Colony.

An important feature of the report is the statement that considerable activity has developed in the search for new areas, most of the drilling in recent years having been confined to existing proved fields. It is hoped that the results will be favourable, and add to the reserves of petroleum. In 1925, the total drilling amounted to 169,153 ft., an increase of 17,261 ft. over that of the previous year, while 99 wells were drilled, of which 65 were productive.

The asphalt industry has now regained its pre-war level, the production in 1925 being 210,107 tons, valued at £125,692.

The only other mineral production in the island relates to limestone and gravel quarries, which are owned partly privately and partly by Government. The combined output of these quarries in 1925 amounted to 199 685 tons, valued at £26,020.

Altogether 5,247 persons were employed in the Trinidad mineral industry, of whom 4,286 were engaged in the petroleum and asphalt industries.

Dredging in the Federated Malay States.—In a recent communication from G. E. Greig, Corresponding Member of the Imperial Institute and Senior Warden of Mines, reference is made to the development of dredging in the middle and lower reaches of the Kinta River. Some details concerning this development are given in the report of the Mines Department for 1925, where attention is called to the opening up of large dredging areas along the Kinta River and elsewhere. The whole of the flat land from Batu Gajah down to the mouth of the river has been actively prospected, and it is estimated that about 30 dredges will be employed in this area. This large area, which has not been worked previously, presents many difficulties owing to its swampy nature and great depth. Dredges are now under construction in Kinta which will dig to a depth of 85 ft.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON MINERAL RESOURCES

The following abstracts of the more important recently published papers and reports on mineral resources relate not only to the resources of the Dominions, Colonies and India, but also to those of foreign countries. The Imperial Institute accepts no responsibility for the opinions expressed by the authors of the papers and reports referred to in these abstracts.

METALS

Aluminium

The *Chemical Trade Journal* (1926, **79**, 309) reproduces from *Chem. Zeit.*, September 4, 1926, an account of a possible new white pigment, aluminate of lead, due to B. Garre of Danzig. Alumina and litharge are mixed in molecular proportions and the mixture, finely granulated,

is heated a long time at 700° C. The colour, at first yellowish, changes to white. No actual melting takes place, the mixture retaining its solid form throughout. The product is a pure white powder with the composition $PbO.Al_2O_3$. It is neither attacked by mineral acids nor blackened by sulphuretted hydrogen. In covering power it is the equal of white lead.

Antimony

Australia.—In view of the fact that there is very little production of antimony ore in the Empire, it is of interest to note that the Queensland Antimony Mines Company is now developing three lines of lode at Northcote in the Chillagoe district. According to a report of the Inspector of Mines for the district (*Queensland Govt. Min. Journ.*, 1926, **27**, 298) 300 bags of concentrate have been shipped from the mine and a considerable quantity of second-grade ore is awaiting treatment in a liquation furnace that is to be erected.

Copper

Northern Rhodesia.—The first return for a month's working of the new plant at the Bwana M'Kubwa mine is now published (*Statist*, 1926, **108**, October 23, 619). In September only one-third of the capacity of the first unit was utilised, about 243 tons of copper oxide containing 80 per cent. of copper being obtained. As the treatment employed is an application of ammonia leaching to a class of ore not hitherto treated by this method, considerable interest attaches to the results obtained. No particulars as regards cost of the treatment have yet been published, but the original estimates of cost were about £45 per ton of refined copper landed at European ports.

Gold

Union of South Africa.—A unique and promising occurrence of gold ore, recently discovered in the Rustenburg district of the Transvaal, was described in a paper read by Percy A. Wagner before the *Geological Society of South Africa* on August 30 last (*Abstr. S. A. Min. Eng. Journ.*, 1926, **37**, 3). The deposit is on farm Waaikraal (No. 205), which is 25 miles N.E. of Rustenburg and 42 miles W.N.W. of Pretoria and consists of an inclined sill of heavy dark-coloured igneous rock, ranging in thickness from 3 ft. 6 in. to 14 ft. The gold contents vary considerably, the highest being found in the middle of the sill. Assays have varied from 1 dwt. to 6 oz. gold per short ton,

the latter over a width of 4 ft. 6 in. The ore-bearing rock has been traced for 308 ft. and extensions will probably be found in both directions. Similar rock has been found under the same geological conditions in adjoining farms, Potgieter's-hoogte (No. 721) on the north-west and on Beestekraal (No. 503) to the south-west. The discoveries, if proved, would show a possible gold-bearing area of considerable extent along the contact line between the norite and granitic rocks.

The economics of gold mining on the Witwatersrand, Transvaal, is discussed by J. H. Curle in "Mining Costs and the Future of Johannesburg" in the *Mining and Industrial Magazine* (August 25, 1926, p. 563). He is of opinion that working costs could be reduced from an average of 19 to one of 15 shillings per ton, which would render possible the mining of 150 million tons of low-grade ore not at present included in the reserves. The abolition of the night shift is recommended and the adoption of two overlapping shifts, so that work is carried on continuously from 7 a.m. to 10 or 11 p.m. He suggests that Mozambique natives be enabled to work on contract so that they earn 7 to 8 shillings per shift, which would dispense with a large percentage of white men.

Canada.—It is stated in *Canadian Official Mining Notes* issued by the High Commissioner in London for Canada that according to the *Natural Resources Intelligence Service* of Ottawa an interesting experiment is being tried at Devil's Canyon, near Barkersville, British Columbia, where a United States company is attempting to drain a lake at the head of the canyon by means of a syphon to recover gold lying at the lake bottom. It is stated that over $2,000,000 worth of gold has already been taken from the bed rock above the lake shore and reports tell of Chinese scooping gold out of the lake with long-handled shovels. The syphon discharges about 200 ft. distant over the side of the canyon, and when it has lowered the lake as far as possible, drill holes will be put down.

Australia.—The Melbourne *Age* (September 8, 1926) reports the discovery of gold ore at Niangala, 40 miles from Tamworth, New South Wales. Auriferous rock was found adhering to the roots of an overturned tree, and an examination of the locality resulted in the discovery of a reef, said to be 5 ft. wide, which has been traced for miles.

The Melbourne *Argus* (September 16, 1916) reports a discovery of gold ore at Glenelg Hills, 50 miles S.S.W. of Southern Cross, Western Australia. The ore-body is a

quartz reef striking N.E. which has been traced so far for 250 ft. A second reef cuts it diagonally. No mining had been done, but panning of samples over 200 ft. on the strike of the first reef indicated a gold content valued at £10 per ton.

A. S. Winter and B. H. Moore, writing in the *Chemical, Metallurgical and Mining Review* (1926, **18**, 483), give an account of their experiments on the flotation of Kalgoorlie ores. As the grinding of ores for flotation must be done in the wet condition, there is no limit in the mine to the use of water for drilling and dust prevention, and better underground conditions are possible. The use of the salt water from the mines is an advantage, a higher-grade concentrate being obtained than with fresh water. Small scale tests showed that on an average a 12½ per cent. concentrate could be obtained, thus reducing the total cost of the subsequent metallurgical treatment to about one-eighth.

Sweet roasting, essential for cyanide treatment, is more easily accomplished with the concentrate than with the original ore. The greater amount of sulphur in the concentrate is an advantage, as it acts as a fuel. A small amount only of oils and reagents is necessary for the flotation, and the total metallurgical cost, including royalty, is estimated at not over 10*s*. per ton.

Tests were made on the ores of nine different mines, the results in two cases of the highest and lowest head values being as follows :

Mine.	Head Value (dwt)	Concentrate.		Tailing Value. (dwt.).	Recovery per cent.
		Per cent of ore.	Value (dwt)		
Boulder-Perseverance . .	16·6	12·5	101·8	0·76	95·40
Lake View-Star . . .	5·49	14·2	32·6	0·38	93·08

The Melbourne *Argus* (1923, August 23) gives information on the recent somewhat sensational discovery of alluvial gold at Edie Creek, New Guinea. The creek, at an altitude of 6,800 ft., extends for about 7 miles. It is reached by crossing the mountainous country between Salamoa, on the coast, and the Bulolo River, a total amount of 30,000 ft. of climbing over razor-backed mountains and the crossing of deep valleys being necessary. The whole country is densely forested with cedar, pine and hardwood trees of great size. It was estimated that not less than 50,000 oz. of gold was stored on the field awaiting better and safer transport. The *Financial Times* (October 10, 1926) stated that 200 men and 1,000 natives were working

on the field and that one shipment of 16,000 oz. of gold had reached Sydney. The gold, being alloyed with silver, is worth only £2 5s. per oz.

According to *Chemical, Engineering and Mining Review* (August 8, 1926) an important discovery of gold deposits has recently been made at Jumblebar, about 9 miles west of No. 23 well on the main road from Meekatharra to Marble Bar, Western Australia. The various deposits are associated with two parallel jasper bars a few chains apart, striking N.E. and S.W., and forming conspicuous ridges over a mile long, on the west of which is granite and on the east, greenstone. The most important deposit is an ironstone lode on the east of the westerly bar. R. C. Wilson, Assistant State Mining Engineer, sampled the outcrop for a distance along the strike of 156 ft. and the average result was 17½ dwt. of gold per ton over 9 ft. of width.

So far no development of the deposits has taken place.

Sweden.—The somewhat remarkable ore deposits found a few years ago in the Västerbotten County, Sweden, continue to attract attention. Svante Wennberg describes them in the *Mining Journal* (1926, **155**, 818) and gives details of the latest discovery, that of the Bolinden mine, from which some 3,000 tons of auriferous arsenopyrite have already been shipped. The average ore from this mine contains per ton, 51 dwt. of gold, 3·8 oz. of silver, 600 lb. of arsenopyrite and 130 lb. of chalcopyrite. The ore-body is 100 ft. wide and in the centre is a band of solid pyrite and chalcopyrite from 3 to 6 ft. wide. An electrolytic plant is to be built for producing refined gold, silver, copper and arsenic. The area of the ore-body at the surface is 14,500 sq. yd., and calculating on a depth of 2,000 ft., which corresponds to the length of the ore-body, some 30,000,000 tons of ore should be available, of which the recoverable gold content is calculated to be worth £100,000,000.

Iron

The severe conditions under which materials are used by the chemical and other industries, such as power production, rendering it necessary that these materials should be capable of resisting extremes of temperature and chemical corrosion, and yet possess good mechanical and working properties, have stimulated a great deal of research. During the last four years a lengthy investigation of the subject has been made at the Hecla works, Sheffield, under the direction of Sir Robert Hadfield, and the results have

been given in a paper by T. G. Elliott and G. B. Willey, entitled "Chemically Resistant Steels—With Special Reference to Very High and Very Low Temperatures," which was read at the Congress of Chemists, held in London in July last.

The following statement summarises the mechanical properties, at normal temperature, of the steels described :

Type.	Yield Point.	Max. Stress.	Elongation.	Reduction of Area.	Brinell Hardness.
	Tons.	*Tons.*	*Per cent.*	*Per cent.*	
Era/H.R. . .	38	58·5	37·5	52	260
Hecla/A.T.V. .	24	46	31	51	190
Era/A.T.V. .	26	49	32	49	220
Hecla/A.M.F. .	29	47	36	56	200
Era/C.R. (A)[1]	27	52	45	55	230
(B)[2]	15	41	75	70	150

[1] *General engineering purposes.* [2] *Fully softened condition.*

The Era/H.R. steel possesses great heat resistance as well as non-scaling properties. At 900° C. its tenacity is 19 tons, and at 700° C., 31 tons per square inch, which compares favourably with the tenacity of a good mild steel at ordinary temperatures, whilst possessing similar ductility. At temperatures up to 800° C. the steel may be loaded with a stress of 6·5 tons per square inch without deformation, which shows its suitability for use with metallic furnace parts where sagging should be avoided. The loss of weight with free access of air at 1,000° C. is only 0·07 gram per 100 square centimetres exposed. In its rigidity and resistance to the action of sulphurous gases the steel is superior to the expensive nickel-chromium alloys used for pyrometer sheaths and other heat resistance purposes. The steel exhibits extraordinary resistance to abrasion at high temperature. In one case slicing links of a mechanical stoker are working continuously in a bed of molten clinker, having an actual life of 1,000 hours steaming time. In zinc-roasting furnaces, water-cooled rabbles have been successfully replaced by rabbles made of this steel, which are worked without water-cooling. In view of the ever-increasing superheating of steam required for higher efficiency in power-station practice the steel will find many applications.

The Hecla/A.T.V. steel is a high-temperature steam-resisting steel specially suitable in the construction of blading of large steam turbines, with which, for the maintenance of a high efficiency, the accuracy of the profile must be maintained.

The Era/A.T.V. steel is specially suitable for the valves

of high-speed internal combustion engines. In one case the rotor of a turbine has worked continuously a a temperature of 800° to 900° C. when running at a speed of 36,000 revs. per minute.

The Hecla/A.M.F. steels possess remarkable tenacity at low temperature. At 195° C. the boiling point of nitrogen, under the Frémont shock test, a value of 50 Kg.M. has been obtained compared with 3 Kg.M. for mild steel under the same conditions ; also at the same temperature the elastic limit is between 23 and 29, and the tensile strength 41 to 48 tons per square inch. The coefficient of expansion may be made equal to that of ordinary steel or iron or to that of glass.

The Era/C.R. non-rusting and non-corroding steels have extraordinary resistance to all classes of chemical attack, not being affected by liquors which have been found very destructive of other corrosion-resisting alloys. For example, sulphuric acid solution in concentration up to at least 25 per cent. by volume has but slight effect. A long list of chemical reagents is given against which the alloy steel is completely resistant.

Canada.—According to *Canadian Official Mining Notes* (September 29, 1926), issued by the High Commissioner for Canada in London, the Natural Resources Intelligence Service at Ottawa has reported that the Mining Corporation of Canada, which has large interests in Cobalt, Ontario, has taken an interest in the iron-ore deposit found some time ago near the Quinze hydro-electric development station, Quebec, the Company's prospectors having staked out 900 acres in which the deposits are found. High-grade magnetic iron-ore is said to occur, the lode in places showing widths up to 60 ft.

India.—According to the *Chemical Age* (1926, **15**, 226) it was stated by A. C. Marten, at a recent meeting of the Burma Engineering Society, that between 64 and 68 miles from Rangoon, within 10 miles of the Rangoon-Moulmein Railway, one of the richest iron-ore deposits in the world had been discovered. The ore is high grade and contains no sulphur. Japan had offered to take all the iron ore that Burma could produce.

Japan.—According to the *Japan Chronicle* (June 23, 1926) a process to treat the almost inexhaustible supplies of low-grade ironsands of Japan has been invented by G. Matsukata. In order to test it on a practical scale the Japanese Government has promised a grant of 200,000 yen

and the assistance of its engineers. The fuel to be used is a lignite which will be distilled at low temperature to produce a coke which still contains some volatile combustible matter. This coke is ground finely. The iron sand also is finely ground, roasted, and then mixed with the powdered fuel. The mixture is fed on to the continuous grate of another furnace, which is heated indirectly by the waste products from the distillation plant. The iron is reduced to the sponge form free from deleterious substances, whilst titanium as oxide can be recovered chiefly from the residue.

Lead and Zinc

Nigeria.—In view of the fact that many attempts have been made to develop lead-ore deposits in the Southern Provinces, the *Report of the Mines Department* for the year 1925 contains some interesting information. During the year over 90 tons of galena were won at Abakaliki and an increase is expected in the current year. Other deposits of galena are being investigated in the Muri and Munshi Provinces.

Canada.—Important developments of lead-zinc ores near Sudbury are foreshadowed in a statement issued by the Bunker Hill and Sullivan Mining and Concentrating Company (*Can. Min. Journ.*, 1926, **47**, pp. 989 and 995). The properties have been tested by diamond drilling for over a year, 60,000 ft. of drilling having been done. They are situated about 20 miles from Sudbury, in the townships of Balfour and Creighton, and comprise about 4,000 acres. The area forms a comparatively level section of ground, approximately parallel to the southern contact of the Sudbury Basin. The ore is believed to occur in a major fault in slates just north of the tuffs. Definite figures of the results obtained by drilling have not been published, but a shaft has been sunk 200 ft. and will be continued to 400 ft., at which point lateral development will be commenced. As a result of this work there has been great activity in staking claims in the vicinity, over a thousand claims having been recorded in the adjoining townships, covering the whole country in the inner basin of the Sudbury nickel field.

In *Canadian Official Mining Notes*, issued from the office of the High Commissioner for Canada, it is reported that a syndicate is about to develop four lead-zinc-silver claims on the Ingenika River, 14 miles above its junction with the Parsnip River, British Columbia. Four parallel veins occur in an ore-zone that has been traced for 700 ft., and

assays have been favourable. The syndicate's plans include the erection of a smelting plant near the confluence of the Findlay and Parsnip rivers, where there are ample coal supplies.

Palladium

British Guiana.—Information on the occurrence in British Guiana of palladium amalgam or palladium mercuride is given in *Government Notice* No. 71, which is reprinted from the *Official Gazette* dated February [illegible], 1925. This new mineral, to which the name "potarite" has been assigned, was first found in the form of small specks near Tukeit in the Potaro district in 1924. Subsequent searching revealed its presence in the form of nuggets and small fragments, weighing from ½ to 12 grams, in the Kangaruma district, some 16 miles away. An examination of various specimens carried out in the Government Laboratory gave specific gravities ranging from 16 to about 13. One specimen, of specific gravity 15·0, was found to contain 34·8 per cent. of palladium (with traces of rhodium, platinum and gold) and 65·2 per cent. of mercury: another, of specific gravity 13·48, contained 45·6 per cent. of palladium and 54·4 per cent. of mercury.

Tellurium

The increasing uses of tellurium in industry are described in an article on the metal in the *Chemical Trade Journal* (1926, **79**, 309). The more important industrial applications are: as an ingredient of high resistance alloys in the manufacture of electrical equipment; for various electro-technical purposes; as a crystal detector in radio sets; in the manufacture of ultramarine; and in bacteriology as a delicate test of sterilisation. Tellurium and its compounds are used in the manufacture of organic dye-stuffs, in staining silver, as a colouring agent in the manufacture of glass and porcelain and as a toning agent in photography. In the colloidal state tellurium gives a blue or brown colour to glass, or as a polytelluride, a pink or red colour. Various oxides of tellurium are used as oxidising agents in metallurgy, so the metal may find considerable application in the steel industry. Silver-tellurium alloys have been recently introduced into the cutlery trade. A tellurium compound is a successful "anti-knock" ingredient of motor fuel. Tellurium alloys with many metals; tin-tellurium alloys show great hardness and tensile strength; aluminium-tellurium alloys possess remarkable powers of elongation.

The continual increase in the demand for electrical

and radio apparatus, and the great growth of electrical undertakings, including railways, will undoubtedly increase the demand for tellurium.

Tin

Uganda.—According to the *Mining Journal* (1926, **155**, 879), the concession of 720 square miles held by the Tanganyika Exploration Co. covers a tin-belt 20 to 30 miles long. The country is mountainous, and pegmatite lodes running through micaceous schist have been traced into the mountains. Tin ore has been found on the slopes and in alluvial terraces on the lower ground, as well as in swamps in the valleys.

NON-METALS

Asbestos

Russia.—Russia is again becoming a prominent producer of asbestos, as is shown by the production of 11,600 tons of that mineral in 1925. The 1926 figure is expected to exceed 20,000 tons (over 5,000 tons were produced in the first four months), which compares favourably with the output for 1913, which was 17,218 tons. According to a report of a meeting of the Industrial Planning Committee of the Supreme Economic Council (*Min. Journ.*, 1926, **44**, 709, August 28), an ambitious scheme of development for the next five years will be put into force. At present only the better grades are being produced, there being no market close at hand for the lower grades, which constitute such a very large percentage of the rock mined, and which, in some instances, constitute a large proportion of the output. The total output aimed at for the next five years is 234,000 tons of the better grades, and attempts will be made to create a market for the low grades. Two new mills will be constructed and much money spent on electrical plant and railway extensions in the Ural district.

Bromine

According to *Mining and Metallurgy* (August, 1926, p. 333) a patent was recently issued in the United States to E. W. Hale and C. G. Fink for the extraction of metals from sulphides, particularly in regard to the extraction of zinc from blende. The reaction between blende and chlorine is very slow, while that between blende and bromine is very violent. The latter reaction is not referred to in text-books, it being generally assumed that the heavier halogen, bromine, acts more slowly than the lighter

chlorine. In the patented process, the leaching of blende is carried out with a solution of chlorine to which a little bromine is added. The bromine acts on the zinc sulphide, first forming zinc bromide, which, in turn, is acted upon by the chlorine forming zinc chloride with the liberation of bromine for further action.

Cement

Australia.—According to *Ind. Aust. and Min. Stand.*, 1926, **76**, 284 (September 9) it is proposed to establish a plant to manufacture aluminous cement (ciment fondu) in Tasmania. A London company is stated to be prepared to establish a plant in Tasmania if an Australian demand of about 20,000 tons per annum can be assured and adequate protection granted. It is estimated that this demand will be realised in a year's time. The natural resources of the island in limestone and water power, with good harbours close at hand, appear to render it eminently suitable for the establishment of such a plant.

Chalk

United Kingdom.—In *Can. Min. Journ.* (1926, **47**, 907, September 17) H. S. Spence describes the manufacture of whiting in England. One of the principal whiting plants is situated at Greenhithe on the Thames. Here chalk is quarried by means of pick and shovel and trammed to the works. As mined, it has a dirty, iron-stained appearance, but yields a fine white product. The chalk is first broken up into a slurry with water in a circular tank, 15 ft. in diameter, by means of four revolving radial arms carrying heavy iron bars. From this the slurry flows through a ⅛-in. wire screen into a launder, and thence into eight open trommels fitted with 180-mesh wire gauze, through which the fine material is washed by jets of water. The fine chalk then passes to a collecting pit, and thence to settling pits, eight of which are arranged in series. When full, the pits are emptied, and the whiting is dried by being spread out on floors paved with iron plates heated by coal-fired furnaces. The dried product is broken up, disintegrated, bolted and bagged. The whiting from the last four pits is designated No. 1 grade and the rest No. 2 grade. A higher priced double-bolted grade is also prepared. The coarse material which does not pass the trommel gauzes is dried and sold for asphalt surfacing. Crude lump chalk is also shipped abroad for making whiting elsewhere, especially to the United States, where there is an import duty of 25 per cent. *ad valorem* on whiting.

Coal

Kenya.—Indications of coal were discovered some twenty years ago in the Taru Desert area and near Samburu. The *Mining and Industrial Magazine* (1926, **3**, 33) gives some information on the renewed search which is being made for this coal. The urgency of securing fuel supplies for the Uganda Railway and for the increasing needs of Kenya Colony is generally recognised.

For the last five years a local syndicate has been holding concessions for oil and coal along the coast, and results obtained secured recently the aid of outside capital from Johannesburg. The area is now being tested by diamond drilling. At one spot favoured by the concessionnaires there are a few irregular leaders of outcrop coal in a river bed; at another a large number of fossilised prostrate trees, the remains of a *dadoxylon* forest, have been discovered. Similar fossils have been found in the Mazeras sandstone, which is considered by David Harris, the engineer in charge of operations, to be similar to the Beaufort formation, which is one of the members of the coal-bearing Karroo System of South Africa.

Canada.—According to *The Times* (October 8, 1926), H. Kerr Thomas, president of the Institution of Automobile Engineers, speaking at Bristol University, stated, on the authority of W. R. Ormandy, the research chemist, that Germany within a year would be independent altogether of outside sources for her petrol by reason of having developed plant for converting brown coal into liquid fuel, and that in the province of Alberta there was enough coal and lignite to supply the world with petrol for a thousand years. The utilisation of this Alberta lignite for producing petrol would render the Empire independent of any foreign country for motor fuel.

The available coal supply of Alberta is a subject dealt with in part in the *Sixth Annual Report of the Scientific and Research Council of Alberta* (p. 40), by John A. Allan, who gives the data supplied by him in 1925 to the Alberta Coal Commission, but slightly modified. He makes clear distinctions between (1) coal resources; (2) coal reserves, and (3) available coal supply. The first must include all known coal deposits, whilst the second represents the amount of coal mineable from them, which is considerably smaller. The report gives an estimate of the available coal supply as deduced from data derived by mining development and by detailed geological field surveys.

In D. B. Dowling's memoir on the coal resources of

Alberta (*Geol. Surv. Canada, Mem.* 59, 1915) the total amount is given at 1,072,400,000 metric tons, but this amount has been often wrongly quoted as the total amount of coal awaiting development.

The author in 1925 published an estimate of the actual and probable coal reserves that might be regarded as an asset to Alberta, based on data then available on the actual and probable coal lands in the three coal areas (Kootenay, Belly River and Edmonton) to a depth of 1,000 ft. and on seams over 2 ft. thick. The following is a summary:

District.	Class of Coal.	Area sq. miles.	Metric Tons.
Kootenay . .	Bituminous coal	972	41,368,320,000
Belly River . .	Sub-bituminous coal	2,880	52,531,200,000
Belly River . .	Lignite	3,996	233,763,840,000
Edmonton . .	Lignite	5,616	

Total coal reserves, 327,663,360,000 tons.

This total is about 300 times as much as the former estimate.

For the Alberta Coal Commission, 1925, more detail was necessary; accordingly the author reviewed all published data on the deposits of Alberta, and estimated the coal available for production in each area. Where possible, the sections or fractions of sections were tabulated for each area, seams over 2 ft. thick to a depth of 1,000 ft. being considered only. Tonnages in short tons were estimated on the following basis, which is considered conservative:

Bituminous	1,800 tons per acre foot.
Sub-bituminous. . .	1,700 " " " "
Lignite	1,600 " " " "

The author's estimates of the *available coal supply* of Alberta are given in the following total figures:

Coal Formation.	No. of Areas.	Class of Coal.	Area sq. miles.	Thickness in feet.	Tonnage (millions).
Kootenay .	10	Bituminous	265	27–70	36,000
Belly River (Saunders)	9	Sub-bituminous	758	6–49	14,400
Belly River (Saunders)	11	Lignite (domestic)	787	5–10	2,170
Edmonton .	14	Lignite	289	15–50	8,630

Total available coal reserve . . 61,200,000,000 tons.
Assuming 50 per cent. recoverable . 30,000,000,000 "

New Zealand.—*The New Zealand Mines Statement*, 1925 (p. C. 2), gives an account of investigations which have been made recently on the briquetting of various New Zealand coals. Coals from the more important coal mines

were tested in the Dominion Laboratory in 1924 and 1925, and it was found that good briquettes could be made from most of the lignites tried (Mataura, Bannockburn, Charleston, Tarata, etc.) without a binder, but this was not the case with brown or bituminous coals. With these a large number of binders were tried, but coal-tar pitch or bitumen proved the most suitable, the resulting briquettes proving of good quality and of moderate cost. It was found that although the brown-coal briquettes stood handling and storage well, they crumbled in the fire. This trouble was cured by mixing the brown coal with 20 per cent. of bituminous coal, the resultant briquettes being of good household quality. With 50 per cent. of bituminous coal, the briquettes were found excellent for locomotive use.

Samples of small coal from various collieries in the Waikato, Reefton, Southland, and Otago districts were sent to Professor W. A. Bone at the Imperial College, London, for examination. His report stated that the best chance of utilising these coals commercially would be either as (1) pulverised fuels for firing boilers and reverberatory furnaces or (2) as briquettes after being crushed and briquetted with 4 to 5 per cent. of pitch or other suitable binder. Also, generally, the best way of "up-grading" these coals would be by a suitable low-temperature carbonisation process (550°–600° C.), because, in addition to yielding satisfactory amounts of fuel oils, the residues would be free-burning and smokeless in combustion.

Other tests are being made in England through the agency of the Mineral Resources Department of the Imperial Institute.

Felspar

Sweden.—In *Can. Min. Journ.*, 1926, **47**, August 13, p. 799, H. S. Spence describes two felspar mines in Sweden which he visited in September, 1925. They are at Margretelund on the mainland, about 20 miles N.E. of Stockholm, and at Ytterby, on the adjacent island of Resaron. The former, which has only been opened up in recent years, supplies about half the Swedish production of felspar (which in 1924 amounted to 18,999 tons). The felspar is obtained from the centre of a pegmatite dike 70 ft. wide intruded along the contact between diorite and gneiss. The outer 20 ft. along each contact consists of an intimate intergrowth of quartz and felspar, and is not amenable to separation by cobbing. Both red microcline and white oligoclase are produced. Cobbing and sorting take place in the pit, clean spar and quartz being trammed down about half a mile to the sorting plant. Here the spar is

crushed, washed and sized, the sorting being achieved by hand picking from belts. The grades produced and prices f.o.b. mine dock (September 1925) were:

No. 1 white spar $10·75 per metric ton.
No. 1 red spar $8·00 per metric ton.
No. 2 white spar $4·00 per metric ton.
No. 3 red and white spar $1·75 per metric ton.

The average alkali content of Margretelund felspar is 12·5 per cent. potash and 2·5 per cent. soda. Germany is the chief buyer. The Ytterby mine was opened in 1780 and is the one noted for the occurrence of rare-earth minerals—gadolinite, fergusonite, yttrotantalite, etc. The mine is a single flask-shaped pit, which has to be entered from the top by means of a bucket or by ladders. The pegmatite dike is about 30 ft. wide, the felspar occurring as large lenses of buff-coloured microcline separated by bodies of white quartz. The waste dumps contain a considerable amount of rare-earth minerals. Only about 65 tons of quartz and 35 tons of felspar are produced monthly, separation being effected by hand cobbing.

Graphite

Madagascar.—Exports of graphite in 1925 amounted to 14,979 metric tons, an increase of 3,413 tons over the previous year. According to the *Echo des Mines* (1926, October 20, pp. 476–7), the actual production was not more than 11,500 tons, the balance being partly from stock and partly of low-grade graphite for further concentration and mixture with high-grade material. The increase in price of graphite has resulted in more active prospecting for new deposits, the number of permits of one category having almost doubled.

Gypsum and Anhydrite

Canada.—*Can. Off. Min. News Letter* No. 100, October 1926, deals with the gypsum industry of Western Canada. The industry has shown steady improvement of late years, chiefly owing to the increase in building activity. Two new properties have commenced production in British Columbia. One at Mayook, near Cranbrook, on the Crow's Nest Line of the Canadian Pacific Railway, is shipping 2 to 3 cars per week to Exshaw, Alta., for use in cement making; the other at Falkland, 40 miles south-east of Kamloops, on the Canadian National Railway, is producing about 100 tons per day, most of which is calcined and made into plaster and plaster board at Port Mann, B.C. A good

trade in these products has been established between Canada and New Zealand with prospects of an extension to China, Japan and South Africa.

Iodine

Chile.—In an article on "The Production of Iodine in Chile" by J. B. Faust, which appeared in *Industrial and Engineering Chemistry* (August, 1926, p. 808) a description is given of the recovery of iodine from caliche, and its preparation for the market.

The amount of iodine in caliche varies from nothing up to 0·3 per cent., the average being probably about 0·15 per cent.; "costra" or lower-grade material contains about 0·05 per cent. The repeated use of the mother liquors in the production of sodium nitrate makes the production of iodine possible commercially. The iodine is accumulated till the liquor content is from 6 to 12 gm. per litre. When sodium nitrate alone is produced all the liquors go to the leaching plant, but when iodine is produced, some of the mother liquor is by-passed to be treated in the iodine plant, the residual liquor being returned to storage.

The mother liquor, which contains iodine as iodates, is mixed with an excess of sodium bisulphite solution (made on the spot by passing sulphur dioxide through sodium carbonate solution) in a wooden vat. The mixture is nearly neutralised with sodium carbonate solution, and the amount of mother liquor necessary to complete the reaction is added. This is a delicate operation. The proper mixing of the liquids is effected by paddles or by blowing in compressed air. Most of the freed iodine sinks to the bottom of the vat, but some, which rises as a scum, is sunk by a jet of water from a hose. After some hours, when all the iodine has settled, the supernatant liquor is drawn off, and the iodine is flushed out of the vat with water into canvas bags, in which it is washed and from which part of the remaining water is removed by a hand press. A "cheese" results which contains 78 to 80 per cent. of iodine and 5 per cent. of salts, viz. nitrates, etc., from the mother liquors; the balance is water.

For the purposes of purification, the cheeses, broken up by mallets, are heated in cement-lined retorts for several days. Iodine and water vapour pass over and are caught in earthenware pipes, 6 to 10 in each series, each pipe being 2 ft. in diameter and 4 ft. long. The joints are packed with jute bagging and mud, except for a few inches at the bottom, through which condensed water drains away.

The iodine is caught as a solid, being deposited as crystals all over the inner walls of the pipes. After cooling for several days the pipe joints are opened and the iodine is removed. It contains 99 per cent. or more of iodine and 0·07 per cent. of "ash," that is some of the salts carried over from the retort, the balance being water. The product is exported in small wooden kegs containing 121 lb. each, which are covered with raw cowhide with the hairy side inside. On drying, the hide contracts and grips the kegs closely, thus reducing loss through volatilisation of iodine.

The recovery of the iodine from the mother liquor treated is probably about 65 per cent. and the average cost of production about 17 pence per pound. In some cases it is as low as 13½ pence. The government export tax on iodine is 10 pence per pound. Allowing for freight and all charges the cost delivered in New York is estimated at 32 pence per pound.

The world consumes about 800 short tons of iodine per year, of which three-quarters is from Chile. Elsewhere seaweed is the chief source. The Chilean product is marketed through a producers' association, production being restricted on account of the limited market, each plant having its quota.

At present not over 2 per cent. of the available iodine is extracted, a waste of iodine unparalleled in any other industry. The author asks where the world's supply of iodine will come from when the Chilean deposits of caliche are exhausted.

Dutch East Indies.—The *Chemical Trade Journal* (August 20, 1926, p. 224) gives an account of the recovery of iodine in Java, principally in the Soerabaya Residency. The yearly output has ranged from 45,000 to 65,000 lb., but for 1926 a production of 130,000 lb., approximately, is expected.

The iodine is exported in the form of cuprous iodide, the principal buyer being Great Britain. The amount exported in 1924 was 188,790 lb., which was about three times that exported in 1923.

The iodine occurs in the form of iodiferous water. A factory has been in existence for some time in the Modjokerto district, Soerabaya Residency, for the extraction of iodine from the water, but the output is small. Nearby is a well of iodiferous water containing 0·121 gm. pure iodine per litre. Drilling resulted in the piercing of an iodiferous water reservoir at a depth of 360 ft., and, later, of a well at 138 ft. The former has a capacity of 46 cub.

yd. of water per day, but this could be increased up to 260 cub. yd. The second well yields 196 cub. yd. per day, but its output is kept down by the limited factory capacity. The production of iodine is still in the experimental stage and more capital is wanted.

In May, 1925, a European company submitted a request for a concession near Banjor Oerip, Goenoeng Gendent district, Soerabaya, where a rich iodine well was pierced.

Lithium Minerals

United States.—The *Engineering and Mining Journal* (1926, **122**, 468) reports that a 30-ft. vein of lepidolite was recently cut in the Trinity Tunnel which is being driven a distance of two miles by the Royal Development Company to reach a copper-gold-silver deposit in the Cascade Range, N.W. of Leavenworth, Washington State, United States. The lepidolite ore-body, which was intersected in the tunnel at a distance of a mile, is almost vertical, and can be mined by the caving system, the wall rocks being hard gneiss.

Petroleum and Allied Products

Under the general title, "Reports on the Progress of Naphthology during 1925," a number of papers reviewing various aspects of the petroleum industry appear in *Journ. Inst. Petr. Techn.* (1926, **12**, No. 57). A. Beeby Thompson, under "Oilfield Practice," draws attention to the increasing depth of wells with consequent increase of pressure, calling for stronger and better equipment. A. Carter writes on drilling methods and tools, E. H. Cunningham Craig on retortable oil-yielding materials, V. C. Alderson on oil-shale and J. McC. Sanders on refining. Oil and gas developments in Canada are reviewed by G. S. Hume of the Canadian Geological Survey. The Royalite Well No. 4 in the Turner Valley field produced 157,081 barrels of gasoline in 1925 from wet gas which, after scrubbing, is sold for 10 cts. per 1,000 cub. ft. in Calgary. The success of this well has resulted in very active drilling in the Turner field. In the Wainwright field the finding of lower gravity oil at depth has also stimulated drilling. In the Fort Norman area, the Imperial No. 2 Discovery well, about 150 ft. from the original well, was deepened in 1925 to 1,602 ft. Oil was obtained at several horizons, but chiefly at 936 and 1,063 ft., the capacity of the well being about 110 barrels per day. A. P. Catherall deals with the West Indies, where steady progress has been made in the development of the already proved areas. Most of the

output of Trinidad was from the Fyzabad-Morne L'Enfer-La Brea districts. He states that commercial quantities of oil have not yet been obtained in Barbados and that drilling operations are expected to commence in British Guiana in the near future. With regard to Japan, Toyokichi Takakuwa records the discovery of a new deep oil-formation in the Nishiyama field and a possibility of increased production from Formosa. The production of oil-shale and shale-oil in Estonia, by P. N. Kogerman, shows a continued increase in the output of oil-shale, while about 2,800 tons of crude shale-oil were produced in two factories in 1925. The final paper, by G. Sell, gives estimates of the world's production of crude oil for 1924 and 1925.

Australia.—The New South Wales House of Representatives has now passed a bill to continue the Shale Oil Bounty Act for an additional three years from August 31 last. The bounty is 3½*d.* per gallon of shale-oil produced. In a report of the debate (*Argus*, 1926, July 29) it was stated that, of the original sum of £270,000 voted, £144,000 was available for the extended period. Hopes were expressed that the new refinery, embodying the "cracking" process, that had just been completed at Clyde, would be successful in treating the shale-oil from Newnes.

In the Melbourne *Argus* (1926, August 25) promising results are reported of a trial run of the Bronder retort at the works of the Australasian Shale Oil Corporation at Latrobe, Tasmania. The run lasted three weeks, during which 40,000 gallons of crude oil were obtained. During the last few days of the trial, 70 tons of shale were treated per day, the recovery of oil being at the rate of 43 gallons per ton.

A report extending to 215 pages on a "Geological Reconnaissance between Roma, Springsure, Tambo and Taroom" (*Queensland Geol. Surv. Publ.* 227, 1926) by H. I. Jensen has just been issued. The report covers an area of about 50,000 sq. miles lying north of the Western Railway and around the Carnarvon Ranges. In the course of the work, seams of good coal and kerosene shale were found, and these may prove to be of economic importance ; but the principal interest of the area is in connection with petroleum. As to the possibilities of finding oil in this part of Queensland, Jensen states that "Recent developments in the study of oilfields and all recent work done on the Injune area combine to render it clearer and clearer that the Injune Series should become a commercial producer of

oil, and that the chances of finding oil-pools in Queensland are far from gloomy." He considers that there are possibilities of considerable oil developments, along a belt about 400 miles in length, between Warwick and Malta.

Colombia.—According to the *Petroleum World* (1926, October, **23**, 365–374) the oil industry of Colombia has entered upon a new and important phase with the commencement of exports of crude oil to the United States. Shipments commenced in July, 1926, on completion of a 360-mile pipeline from Barranca Bermeja, the headquarters for the oilfields, to Cartagena on the coast. The capacity of the pipeline is given as 30,000 barrels of crude oil per day, which is about half the present potential production of the wells already drilled. Of the four structures that have been proved within a radius of 50 miles, the Infantas field has been proved to cover an area of 4,000 acres, and has 100 wells already drilled, with an estimated capacity of 70,000 barrels per day. La Cira field, 2½ miles east of Infantas, has 5 wells drilled, with an average production of 136 barrels per day. The San Louis structure, 14½ miles farther to the south-west, is being intensively drilled by 16 rotary rigs.

United States.—In this BULLETIN (1926, **24**, No. 1, pp. 110–112), the conclusions were stated of a Committee of the American Petroleum Institute with regard to the petroleum reserves of the United States. These conclusions were of an optimistic character and in marked contrast to a report issued recently by the Federal Oil Conservation Board, the subject of an editorial in *Eng. Min. Journ.* (1926, **122**, 443). The Board finds that there is only six years' supply of recoverable oil in pumping and flowing wells in proved sands, and states that the assumption is not warranted that any large part of the so-called "billion acre reserve" will be productive. Suggestions are made for preventing waste in new fields by co-operative methods, for uniformity of State laws and for other forms of co-operation in field work and research within the industry.

Pigment Minerals

Egypt.—A correspondent in the *Mining Journal* (1926, **155**, 816) describes various mines lately rediscovered by Labib Nasseem near Aswan, from which the ancient Egyptians took their material used for painting and dyeing monuments and cloths. The area in which the deposits are found amounts to over 1,000 sq. kilometres. The discoverer holds from the Government 4 concessions of

110 acres, estimated to contain 3,000,000 tons of colours. Two other concessions of 1,300 acres granted within the area contain over 20,000,000 tons.

Costs of production are low on account of cheap native labour, absence of taxes on the starting of an Egyptian industry and absence of export duties. Drying can be effected by the heat of the sun, so fuel and drying machinery are not wanted.

The colours are used for making oil and water paints, for distempers, for colouring cement tiles, for dyeing paper, for making printing inks and for colouring linoleum.

Some concessions contain red oxide of iron of 88 per cent. purity, and it has been estimated that on a scale of operations of 20,000 tons per year, oxide of iron could be delivered in bags c.i.f. European port for £4 per ton.

The several deposits are detailed as follows: variously coloured oxides of iron of best quality are found east of Aswan and Khattara; barytes and green earth, east of Tahta; purest white chalk, east of Samallout; yellow ochre, at the site of the colour factory at Helwan and east of Cairo; red clay, east of Tura; raw sienna and umber at Hohag.

Precious Stones—Diamonds

Union of South Africa.—Considerable interest has been aroused of late by reason of the greatly increased production of alluvial stones from the new fields in the Western Transvaal, and by new discoveries on the coast of Namaqualand. In the Transvaal, 73,429 cts. were produced in July as against 41,871 in June and 11,010 in January. The great increase is due almost entirely to the new Lichtenburg field, where 61,330 cts. were produced in July. Experts consider that the increase in production is likely to continue. The Lichtenburg stones are said to vary in size from 30 cts. down to $\frac{1}{10}$ ct., the average value being between £4 and £5 per ct. A fine red stone of 18 cts. was recently found there. The average value of the alluvial stones found in the Transvaal is, however, substantially decreasing, having dropped from £8 14*s*. 8*d*. per ct. in February to £3 5*s*. 6*d*. in July.

About twelve months ago diamonds were discovered south of Port Nolloth on the Namaqualand coast. Activity in this area has extended during the past few months, and more promising finds have been made both north and south of the port. The stones are stated to be of excellent quality and about a thousand pounds' worth have been recovered so far from the northern field. The big diamond syndicates are said to be closely watching developments,

and suggestions have been made that these new fields may ultimately rival the Lüderitzbucht-Kolmanskop-Pomona fields of South-West Africa, which they so closely resemble (*Min. Indus. Mag. S. Afr.*, 1926, **2**, 567, August 25; and **3**, 31, September 8).

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the months of September and October, 1926.

The publications issued by the Governments of the Crown Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

General

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1925. Pp. 211 x, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 4*s*. 6*d*. net.

Annual Report of the Geological Survey Department, Nyasaland Protectorate, for the Year 1925. Pp. 7, 13 × 8. (Zomba: Government Printer.)

Colonial Reports—Annual. No. 1292. Northern Rhodesia. Report for 1924–25. Pp. 22, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 1*s*. net.

Report of the Secretary, Department of Mines and Public Works, Southern Rhodesia, on Mines, for 1925. Pp. 26, 13 × 8. (Salisbury, Rhodesia: Government Printer, 1926.)

Report by His Britannic Majesty's Government to the Council of the League of Nations on the Administration of Tanganyika Territory for the Year 1925. [Colonial No. 18.] Pp. 93, 9½ × 6, map in cover. (London: H.M. Stationery Office, 1926.) Price 3*s*. 6*d*. net.

Summary Report of the Geological Survey of Canada, 1924, Part C. Pp. 268, maps, 9½ × 6½. (Ottawa: King's Printer, 1926.)

North Shore of Lake Huron. By W. H. Collins. *Mem.* 143, *Geol. Surv. Canada*. Pp. 160, maps in cover, 9½ × 6½. (Ottawa: King's Printer, 1925.) Price 30 cents.

Sixth Annual Report of the Scientific and Industrial Research Council of Alberta, 1925. Pp. 65, 10 × 6½. (Edmonton: King's Printer, 1926.)

Annual Report of the Minister of Mines, British Columbia, for the Year 1925. Pp. 466, 10½ × 7½. (Victoria, B.C., King's Printer, 1926.)

Pahang Administration Report for the Year 1925. By A. F. Worthington. (Kuala Lumpur: Federated Malay States Government Printing Office, 1926.)

Report of His Britannic Majesty's Government to the Council of the League of Nations on the Administration of Palestine and Transjordan, for the Year 1925. Pp. 166, 9½ × 6. (London: H.M. Stationery Office, 1926). [Colonial No. 20.] Price 5*s*. 6*d*. net.

Mining Review for the Half-year ended December 31, 1925. *No.* 43, *South Australia Dept. Mines*. Pp. 82, 9½ × 6. (Adelaide: Government Printer, 1926.)

New Zealand Mines Statement for the Year 1925. Pp. 56, 13 × 8. (Wellington, N.Z., Government Printer, 1926.)

Twentieth Annual Report (New Series) of the Geological Survey Branch, New Zealand. Pp. 12, 13 × 8½. (Wellington: Government Printer, 1926.) Price 6*d.*

The Geology of the Huntly-Kawhia Subdivision, Pirongia and Hauraki Divisions. By J. Henderson and L. I. Grange. *Bull. No.* 28 (New Series), *Geol. Surv. Branch, N.Z.* Pp. 112, 11 × 8½, maps in cover. (Wellington: Government Printer, 1926.)

Die bergbauliche Gewinnung des niederrheinischwestfälischen Bergbaubezirks im Jahre 1925. By E. Jüngst. *Glückauf* (1926, **62**, 1065–1069, 1098–1103).

Jaarverslag van den Hoofdingenieur der Mijnen over het Jaar 1925. Pp. 118, 8 × 5½. (Gravenhage: Algemeene Landsdrukkerij, 1926.)

Reseña Geologica y Metalogénica de la Sierra de Cartagena. By J. Meseguer Pardo. *Rev. Min.* (1926, **77**, 453–456, 465–468).

Report on the Economic Situation in the Belgian Congo, June, 1926. By J. P. MacGregor. Dept. Overseas Trade. Pp. 38, 9½ × 6. (London: H.M. Stationery Office, 1926.) Price 1*s.* 6*d.* net.

Geology and Mineral Resources of the Joliet Quadrangle. By D. J. Fisher. *Bull. No.* 51, *Iowa State Geol. Surv.* Pp. 160, maps in cover, 10 × 7. (Urbana, Illinois: 1925.)

Preliminary Report on the Economic Mineral Resources of Calhoun County. By J. E. Lamar. *Rept. Investig. No.* 8, *Illinois State Geol. Surv.* Pp. 21, 10 × 7. (Urbana, Illinois: 1926.)

La Prospeccion Subterranea por los Métodos Geofísicos. By J. Meseguer Pardo. *Rev. Min.* (1926, **77**, 517–522, 533–539, 549–553).

Magmas and Igneous Ore Deposits. By J. H. L. Vogt. *Econ. Geol.* (1926, **21**, 207–233, 309–332, 469–497).

METALS

Aluminium

The Production of Secondary Aluminium and Aluminium Alloys from Scrap. By R. J. Anderson. *Mining Mag.* (1926, **35**, 142–154).

Antimony

The Antimony Deposits of the Murchison Range. By W. H. Jones. *S. Afr. Min. Eng. Journ.* (1926, **37**, 665–666).

El Antimonio. By L. de Silva. With section on Antimony Smelting in China. By C. Y. Wang. *Bol. Minero* (1926, **21**, 279–323).

Copper

Uses for Copper Slag in Construction Work. By E. E. Thum. *Eng. Min. Journ.* (1926, **122**, 285–288).

Gold

The Gold and Antimony Deposits of the Murchison Range. *Min. Ind. Mag. S. Africa* (1926, **2**, 421–422).

Barberton Mining. A Survey of the Barberton Goldfields. By R. Raphael. *Min. Ind. Mag. S. Africa* (1926, **2**, 527–529).

Flotation of Rand Pyritic Gold Ores. By H. Hardy Smith. *Eng. Min. Journ* (1926, **122**, 175–178, 215–221).

Gold Mining in Nova Scotia. By J. C. Murray. *Bull. Can. Inst. Min. Met.* (1926, No. 166, pp. 271–286).

Geology and Economic Possibilities of Sutton Lake Area, District of Patricia. By J. E. Hawley. *Ann. Rept. Ont. Dept. Mines* (1925, **34**, Part 7, 1–56).

Treatment of Gold-bearing Quartz of the Kolar Gold Field. By R. H. Kendall and A. F. Hosking. *Trans. Inst. Min. Met.* (1924–25, **34**, Part 2, 66–117 with discussion).

The Aberfeldy District, Gippsland. By W. Baragwanath. Appendix on Petrology. By D. J. Mahony. *Mem. No.* 15, *Geol. Surv. Victoria.* Pp. 45, with maps and sections, 13 × 8. (Melbourne: Government Printer, 1925.)

Half a Century of Mining in the Black Hills. By F. C. Lincoln. *Eng. Min. Journ.* (1926, **122**, 205–214).

Iron

New Zealand Iron Industry. By J. A. Heskett. Paper before Dominion Min. Conf., Wellington, Feb., 1926. Abstr. *Chem. Eng. Min. Rev.* (1926, **18**, 349–353).

Date Technice asupra fabricatiunii fontei in România. By D. Perieteanu. *Ann. des Mines de Roumanie* (1926, **9**, 443–461 with diagrams).

Report on the Heterogeneity of Steel Ingots. By a Sub-Committee on behalf of the No. 5 Committee of the Iron and Steel Institute. *Journ. Iron and Steel Inst.* (1926, **113**, 39–176 with discussion).

Lead

A Short History of the Discovery and Development of the Sullivan Mine; the Solution of its difficult Metallurgical Problems; and a Description of the Plants used in the Reduction of its Ores. By W. M. Archibald and others. *Trans. Inst. Min. Met.* (1924–25, **34**, Part 2, 1–65 with discussion).

Geology and Mineral Deposits of Windermere Map-area, British Columbia. By J. F. Walker. *Mem.* 148, *Geol. Surv. Canada.* Pp. 69, 9½ × 6½, 8 pl., plans. (Ottawa: King's Printer, 1926.) Price 20 cents.

Nickel

The Nickel Industry. By P. D. Merica. *Bull. Can. Inst. Min. Met.* (1926, No. 166, pp. 173–212).

Silver

The B.C. Silver Mines, Portland Canal District, Northern British Columbia. By C. A. Banks. *Mining Mag.* (1926, **35**, 86–90).

Tin

Tin in the Mergui District, Lower Burma. By J. Morrow Campbell. *Mining Mag.* (1926, **35**, 115–160).

Tin Mining in Malaya. By L. G. Attenborough. *Trans. Inst. Min. Met.* (1924–25, **34**, Part 2, 118–161 with discussion).

The Gopeng Consolidated Tin Mines. By A. G. Glenister. *Mining Mag.* (1926, **35**, 73–85).

NON-METALS

Cement

Le Ciment en Afrique Australe. By H. Auban. *Bull. des Mines de Madagascar* (1926, No. 39, pp. 40–41).

Coal, Coke and By-products

The Tweefontein Collieries Tar Plant. *S. Afr. Engineer* (1926, **16**, 59–62).

Geology of the Area between Athabaska and Embarras Rivers, Alberta. By R. L. Rutherford. *Rept. No.* 15, *Sci. Ind. Res. Council, Alberta.* Pp. 29, maps in cover, 10 × 7. (Edmonton: King's Printer, 1926.)

Hat Creek Coalfield and Upper Hat Creek Coal Deposit, B.C. By G. Wilkinson, J. D. Galloway and B. R. MacKay. *Ann. Rept. Minister of Mines, British Columbia, for* 1925. Pp. 305–333, 10½ × 7½. (Victoria, B.C., King's Printer, 1926.)

The Maitland Coalfield, N.S.W. By Leo J. Jones. Lecturette at Mining Museum, Sydney, April 26, 1926. Abstr. *Chem. Eng. Min. Rev.* (1926, **18**, 397–402).

Sur les Constituants Macroscopiques des Charbons Campinois. By O. De Booseré. *Ann. des Mines de Belgique* (1926, **27**, 369–396).

Matériaux pour l'étude du Bassin de Namur: Le Bassin Houiller de la Basse-Sambre. By X. Stainier. *Ann. des Mines de Belgique* (1926, **27**, 491–555).

Installation de Lavage par Flottation aux Mines d'Aniche. By Sauvet. *Rev. de l'Ind. Min.* (1926, No. 136, Part 1, pp. 355–368).

Le Charbon de la Sakoa. By J. Goursat. *Bull. des Mines de Madagascar* (1926, No. 42, pp. 85–93 and geol. sketch-map).

The Examination of Coking Coals and Estimation of their Value. By R. Kattwinkel. *Fuel in Science and Practice* (1926, **5**, 347–355).

Vergleichende Untersuchungen von trocken und nass gelöschtem Koks. By F. Müller. *Glückauf* (1926, **62**, 1128–1132).

La Carbonisation à basse Température en Angleterre. By C. Demeure. *Ann. des Mines de Belgique* (1925, **26**, 1201–1261; 1926, **27**, 63–89, 437–489).

Low-Temperature Carbonisation of Coal. The Pehrson Process. *Anglo-Swedish Tr. Journ.* (1926, **18**, 231, 233).

Coal Blending: A Review of General Principles as Applied both to High- and Low-Temperature Carbonisation. By D. Brownlie. *Journ. Iron and Steel Inst.* (1926, **113**, 229–283 with discussion).

The Parr Process of Low-temperature Carbonisation of Coal. By W. R. Chapman. *Fuel in Science and Practice* (1926, **5**, 355–361).

Some Problems in the Carbonisation Industries. By B. H. M. Spiers and T. Campbell Finlayson. *Indus. Chem.* (1926, pp. 315–318).

Low Temperature Carbonisation of Coal, with special reference to the Bikaner Lignite and the "Tozer" Process. By A. W. E. Standley. *Journ. Inst. Eng.* (*India*) (1926, **6**, 146–161).

L'Analyse exacte des Gaz de Distillation. By E. Connerade. *Ann. des Mines de Belgique* (1926, **27**, 587–614).

Oil from Coal. By H. Nielsen. *Iron and Coal Tr. Rev.* (1926, **112**, 919–920, 961–962, 1008–1009).

Corundum

Corundum in the Union of S. Africa. By C. J. N. Jourdan. *Comm. and Ind. Gaz. S. Africa* (1926, **1**, 63–65).

Diatomite

Diatomaceous Earth. Its Limitless Applications. By C. W. Davis. *British Clayworker* (1926, **35**, 132–134).

Fluorspar

The Illinois-Kentucky Fluorspar Industry. By A. H. Fay. *Eng. Min. Journ.* (1926, **122**, 165–169).

Gemstones

A Visit to the Gem Districts of Ceylon and Burma. By F. D. Adams. *Bull. Can. Inst. Min. Met.* (1926, No. 166, pp. 213–246).

Les Gemmes Malgaches. By A. Lacroix. Lecture before the Académie des Sciences Coloniales. *Bull. Econ. de Magadascar* (1925–26, **22**, 54–60).

Graphite

Graphite Mining in Italy and Austria. By H. S. Spence. *Can. Min. Journ.* (1926, **47**, 776–778).

Le Graphite et le Mica à Madagascar au cours de l'année 1925. *Bull. Econ. de Madagascar* (1926, No. 1, pp. 81–83).

Gypsum

Drying of Gypsum. Some Notes on Modern German Practice. *Indus. Chem.* (1926, **2**, 343–346).

Nitrates

The Separation of Potassium Nitrate and the Recovery of other Salts from crude Indian Saltpetre. By Mohammed Abdul Hamid. *Chem. and Ind.* (1926, **45**, 315T–320T).

Petroleum and Allied Products

Administration Report of the Inspector of Mines for the Year 1925. Trinidad and Tobago. *Council Paper No.* 65 of 1926. Pp. 6, and charts, 13½ × 8½. (Trinidad: Government Printer, 1926.) Price 2*s*.

The Oil Problem in Western Australia. By F. G. Clapp. *Econ. Geol.* (1926, **21**, 409–430).

I Giacimenti petroliferi della Germania Nord-occidentale. By E. Paparella. *Rass Min. Met. Chim.* (1926, **65**, 25–29, 51–57).

Der Unterbau des Erdölgebietes von Nordost-Mexiko. By W. Staub. *Zeits f. prakt. Geol.* (1926, **34**, 120–125).

Oil and Gas Accumulation in the Clinton Sand of Ohio. By W. L. Russell. *Econ. Geol.*. (1926, **21**, 538–559).

The Oil Regions of the Caspian Sea. By D. Sokolov. *Petr. Times* (1926, **16**, 221–224, 269–275, 341–346).

The Russian Oilfields in 1924–1925. By B. B. Zavoico. *Petr. Times* (1926, **16**, 137–140, 199–200).

Quartz

Some Uses of Quartz and Silica Products in Industry. By J. Stewart Remington. *Indus. Chem.* (1926, **2**, 347–350).

Refractories

Vorkommen und Gewinnung der feuerfesten Tone und Schiefertone im Bezirk Mährisch-Trübau, Nordmähren, Tschechoslowakei. By A. Kanka. *Montan. Runds.* (1926, **18**, 431–432, 463–468, 489–496).

Sulphur and Iron Pyrites

Nota Sobre la Explotación de Masas de Piritas en Huelva. By L. Plichon. *Rev. Min.* (1929, **77**, 441–443).

NOTICES OF RECENT LITERATURE

TUNGSTEN: A TREATISE ON ITS METALLURGY, PROPERTIES AND APPLICATIONS. By Colin J. Smithells, M.C., D.Sc., viii + 167. (London: Chapman & Hall, Ltd., 1926.) Price 21*s*. net.

This is a really excellent book, and should be a standard work for some considerable time. When, as knowledge advances, the need for a more up-to-date account of this interesting metal is required, none could be better qualified than the author to supply the need. As a research worker in the laboratories of the General Electric Company, makers of the Osram lamp, Mr. Smithells is mainly concerned with the manufacture and utilisation of pure ductile tungsten, and the main part of the book is confined to these. Of the 161 pages of text, 41 are devoted to an outline of the occurrences of tungsten ores and the preparation and reduction of tungstic oxide. The remaining 120 pages, which form the really valuable portion of the book, contain chapters on the manufacture of ductile tungsten, metallography, properties, industrial applications and determination of impurities. The manufacture of tungsten for use in alloys, for which purpose by far the greater part of the production is used, is given only in brief outline, and it might have been better to have given a less comprehensive title to the work.

The history of the methods employed to make a tungsten filament, before it was known how to make the metal ductile at ordinary temperatures, is clearly told and is of great interest. It is only twenty years since the first patent was taken out by Coolidge for a method of making tungsten ductile at ordinary temperatures, and the apparatus employed remains essentially unchanged, although the processes now used may vary in detail. The successive steps taken in the production of a filament, ·003 mm. in diameter, starting from tungsten powder, are described in detail and are illustrated by excellent photographs of machines and photomicrographs of sections at different stages of manufacture.

The value of tungsten for filaments lies in its low vapour pressure, combined with the high melting-point of the metal, which is probably higher than that of any substance other than carbon. The physical constants at high temperatures have been fully worked out, and are given in numerous tables and explanations in the text. A new method of estimating very small quantities of impurities by spectroscopic analysis, devised by J. W. Ryde, one of

the author's colleagues, is given in detail and forms a valuable contribution to the book.

In conclusion, both publishers and author are to be congratulated on the style in which the book is turned out and on the excellent figures and illustrations that help to a good understanding of the text. Despite the large amount of data contained, the book is clearly written and easily readable throughout. The price is very reasonable considering the number of plates. An adequate index is provided.

INDUSTRIAL FURNACES. By W. Trinks. Volume I, Second Edition, 1926. Pp. vii + 352, 9¼ × 6¼. Price 22*s*. 6*d*. Volume II, 1925. Pp. xiv + 405, 9 × 6. Price 27*s*. 6*d*. (New York : John Wiley & Sons, Inc. ; London : Chapman & Hall, Ltd.).

The author, who is Professor of Engineering at the Carnegie Institute of Technology in the United States, has produced a valuable work which deals with the matter of industrial furnaces from all points of view. The two volumes are complementary, yet each is complete in itself. There is no other book available on the subject of the first volume, comparable with this in importance, and the second is the only one of its kind, consequently the writer has had very largely to break new ground.

The first volume, in its second edition, is a reprint of the former edition with an appendix to bring it up to date, and consists of a revision of a series of articles which had previously appeared. It deals with the principles and conditions which belong to all industrial heating operations and the design of all classes of furnace. The subject-matter is divided into sections on the capacity, the economy and thermal efficiency, the strength and durability, and the movement of gases in furnaces. The second volume, largely giving the results of actual experience, would appeal to the operator of furnaces. Its contents include fuels, furnace types and furnace equipment, their selection and influence upon furnace operation. A great deal of equipment is described. Under the section on fuels much information is given on the properties of different classes of fuels used for heating furnaces and on the equipment necessary for their preparation. Descriptions are given of the plant used for the burning of the different fuels, and for the conversion of electrical energy into heat ; devices for the controlling of furnace temperature and furnace atmosphere, and their practical operation ; labour-saving devices ; the repair of furnaces, and automatic devices for the feeding of fuel and their control. The last

two chapters give a critical comparison of differing types of furnace and of the fuels suitable for them.

No less than 575 line-drawings, diagrams and other illustrations and charts, as well as a number of useful tables, testify to the work done by the author. Here and there are examples of practice in which all the calculations are worked out in detail.

The work is one which can be highly recommended to the furnace engineer, and its production is a credit to the publishers.

THE MAKING AND TESTING OF PORTLAND CEMENT. Pp. xix + 129. 10 × 6¼. (Hull: G. & T. Earle (1925) Ltd.). Price 10s.

This volume, which is published by a well-known firm of cement manufacturers, is the fourth edition of a work which first appeared in 1904.

The actual manufacture of cement is described very briefly in the first chapter, the remainder of the work being chiefly devoted to the mechanical and chemical testing of cement and concrete.

A very useful feature is the inclusion in Chapter II of the whole of the latest British Standard Specification for Portland cement, accompanied by an explanation of each section and a description of Messrs. Earle's methods of conducting the necessary tests, together with comments on some factors which influence the accuracy of the results obtained.

There are, however, several points in connection with these tests concerning which a record of the firm's experience would have been welcome, such as the effect of different methods of hand sifting on the figure obtained for "fineness," and the influence of different methods of filling the briquette moulds on the tensile strength of the neat cement. No detailed instructions for carrying out either of these operations are given in the Standard Specification.

It is interesting to note that the firm attach considerable importance to results of compression tests, and for the purpose of filling the moulds with the 3 : 1 cement-sand mixture employ a "Kleb Hammer." This is somewhat similar to the 6-hammer compacting machine designed and made at the Imperial Institute, and used at the Institute for a number of years past.

The second half of the book is devoted chiefly to the making and testing of concrete, with special reference to the correct proportioning of the aggregate. The statement on page 89 to the effect that cement sand briquettes made by ramming the mixture into the moulds develop a tensile strength 30 per cent. higher than similar briquettes

compacted by the standard spatula is open to question, the experience of many workers being that the results obtained by the two methods differ but little with the generality of cements.

A useful feature of this section is the inclusion of a table showing the compressive strengths of concretes made from different aggregates.

The appendix contains a description of the methods adopted for the chemical analysis of cement.

The book is well printed; it contains a number of good illustrations and should prove of value to all interested in the subject of cement.

ZINC OXIDE: HISTORY, MANUFACTURE AND PROPERTIES AS A PIGMENT. By Dalton B. Faloon. Pp. x + 145, $8\frac{1}{2} \times 5\frac{3}{4}$. (London: Constable & Co. Ltd., 1926). Price *12s.*

This book opens with introductory chapters on the history of zinc and occurrences of zinc ores, followed by chapters on the characteristics of zinc oxide, the French process of manufacture, and the American process of manufacture as practised in the Eastern and Western States respectively. This part of the book is loosely written and in places is inaccurate. It is marred also by numerous misprints. The author claims that the work is designed to help the users of zinc oxide in the various industries in which it finds application. It will certainly be of little use to the manufacturers of the pigment.

The last forty-nine pages contain useful data on the physical and chemical specifications of zinc oxide for various purposes, as required by the United States Government, and the trade. Methods of sampling and testing are also included.

There is a distinct need for an authoritative and up-to-date work on the manufacture of zinc oxide, and it is unfortunate that this work is so incomplete.

The book is well printed and illustrated, and is provided with a good index.

THE SPONTANEOUS COMBUSTION OF COAL: THE MOST READILY OXIDISABLE CONSTITUENTS OF COAL. By W. Francis and R. V. Wheeler. Safety in Mines Research Board Paper No. 28, Mines Department. Pp. 43 + 4 plates, $9\frac{3}{4} \times 6\frac{1}{4}$. (London: H.M. Stationery Office, 1926.) Price *1s. 6d.*

This paper gives an account of some recent work the aim of which was to determine which constituents of coal are most readily attacked by oxygen.

The main cause of the spontaneous combustion of coal is most often direct action of the oxygen of the air on the coal substance. Coal is a mixture of widely differing compounds, as is shown by the readiness with which a bituminous coal can be divided by means of organic solvents into fractions that differ in general character.

The research carried out by the authors has shown that the portion of the coal to which spontaneous combustion is due is the ulmin portion, the characteristics of which have, therefore, been examined in some detail. The relative degree of liability to spontaneous combustion of a particular coal can be estimated by determining the proportion and character of the ulmin compounds that it contains.

GEOLOGICAL MAP OF THE PROVINCE OF ALBERTA, CANADA. By John A. Allan, Geological Survey Division. $32\frac{1}{2} \times 18$. (Edmonton, 1925.)

This map, issued as *Map No.* 10 by the *Scientific and Industrial Research Council of Alberta*, and referred to in their *Sixth Annual Report*, 1925, is the first attempt to give a complete geological representation of the province. It is on a scale of twenty-five miles to the inch, and is printed in fourteen colours. The excellent earlier maps of D. B. Dowling and other geologists only included small areas in the southern part of Alberta.

The compilation of the base map was begun in 1923, the geographical, topographical and geological information being taken from all the latest available information and from private investigations.

Many changes are to be noted in the position of geological boundaries, either approximate or probable, when compared with other maps, but accurate information on the distribution of the formations is still lacking. The difficulties of producing the map will, therefore, be realised. No attempt has been made to subdivide either the Palæozoic rocks in the South-West or the Upper Cretaceous formation which occupies a large proportion of Northern Alberta.

MONTHLY MINERAL AND METAL STATISTICS.

MARCH—SEPTEMBER, 1926.

Owing to lack of space, only the more important monthly statistics relating to the production of and trade in the principal minerals and metals can be included in the following pages. Anyone requiring further information on these or other minerals and metals should communicate with the Director, Imperial Institute, South Kensington, London, S.W.7.

Where the descriptions " Imports " and " Exports " are used without qualification in the following pages, " Imports " is equivalent to " Imports for home consumption," while " Exports " represents " Exports of domestic produce."

A blank space in the columns indicates that information has not yet been received, whereas a dash indicates that, so far as can be ascertained, no production or trade took place.

The units of quantity adopted for these returns are the British statute hundredweight and ton of 112 lb. (avdp.) and 2,240 lb. (avdp.) respectively, the imperial gallon and the metric carat. For precious metals the troy ounce has been used.

In those cases where values expressed in pounds sterling are given in place of quantities, the original values have been converted to pounds sterling at average rates of exchange with the exception of those for the Union of South Africa, Australia and New Zealand, in which cases the original currency values are given.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
ALUMINIUM								
BRITISH EMPIRE								
United Kingdom:								
Exports of ingots, blocks, etc.	Long ton	3,717	399	182	263	180	489	336
Canada:								
Imports of cryolite . .	Long ton	673	22	25	343	244	155	337
Imports of alumina . .	do.	56,922	3,831	3,689	5,916	3,954	5,572	5,706
Exports of blocks, bars, etc. .	do.	16,637	546	479	707	595	757	799
British Guiana:								
Production of bauxite . .	Long ton	194,339						
Exports of bauxite . .	do.	174,999	25,678	15,980	21,695	14,260	15,968	12,381
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.:								
Imports of bauxite . .	Long ton	3,542	10	58	193	339	258	130
Imports of crude aluminium and scrap	do.	990	28	52	99	89	93	—
Czechoslovakia:								
Imports of cryolite . .	Long ton	909	75	70	25	85	50	42
Imports of sheets, plates, etc.	do.	182	8	8	39	44	14	7
France:								
Production of bauxite . .	Long ton	400,001	37,980	32,735	36,809	33,931	37,896	31,314
Exports of bauxite, etc. . .	do.	211,510	21,133	20,105	24,873	12,725	28,039	15,977
Exports of anhydrous alumina	do.	21,188	1,466	2,416	1,499	2,212	2,781	2,138
Exports of hydrate of alumina	do.	3,774	3	94	2	77	275	111
Production of aluminium .	do.	21,000						
Exports of ingots, scrap and wrought aluminium . .	do.	3,244	68	101	148	111	99	91
Germany:								
Exports of crude bauxite and natural cryolite . . .	Long ton	469	—	—	—	—	—	1
Production of aluminium .	do.	25,800						
Exports of crude, scrap and wrought aluminium . .	do	7,489	2,313	990	1,094	1,248	1,254	1,112

Imports of crude, scrap and wrought aluminium	do.	10,734	246	253	343	543	920	332
Italy:								
Production of bauxite	Long ton	192,000						
Production of aluminium	do.	1,850						
Imports of ingots, etc., sheets, bars and tubes	do	6,579	451	337	480	339	251	56
Norway:								
Total imports of bauxite	£	284,202	—	—	42,560	—	—	581
Total imports of cryolite	£	75,994	3,912	11,491	6,749	8,753	5,307	6,311
Total imports of alumina	£	513,258	110,966	41,947	93,862	52,644	94,448	81,980
Exports of ingots and sheets	Long ton	20,319	1,713	1,907	2,288	1,887	1,836	1,387
Switzerland:								
Exports of blocks, etc., scrap, sheets, tubes, and wire, including some alloys	Long ton	15,639	1,029	1,490	1,718	1,621	1,103	729
United States:								
Production of bauxite	Long ton	316,540						
Total imports of crude bauxite	do.	353,696	42,369	25,976	34,178	23,003	20,771	4,600
Total imports of cryolite	do.	9,844	34	27	12	35	2,515	2,519
Exports of bauxite, etc.	do.	78,570	3,934	9,353	6,152	6,973	8,187	5,579
Total imports of ingots, scrap and alloys, plates and sheets, etc.	do.	19,425	3,479	2,669	2,162	1,976	2,885	2,152
Exports of ingots, scrap and alloys, plates and sheets, etc.	do.	5,644	57	284	274	486	271	474
Dutch Guiana:								
Exports of bauxite	Long ton	84,150						
ASBESTOS								
BRITISH EMPIRE								
United Kingdom:								
Total imports of raw asbestos, fibre and waste, including asbestic:	Long ton	26,118	2,377	1,297	3,083	3,618	1,425	2,096
Re-exports of raw asbestos, fibre and waste, including asbestic	do.	5,580	250	168	322	264	202	56

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
ASBESTOS (*contd.*)								
Southern Rhodesia:								
Production of asbestos . .	Long ton	30,669	2,909	3,177	2,865	2,779	2,942	2,604
Exports of asbestos . .	do	30,107	4,252	3,067	2,963	2,832	2,804	
Union of South Africa:								
Sales and shipments in Transvaal	Long ton	6,810	1,124	301	1,059	691	1,159	613
Sales and shipments in Cape of Good Hope	do.	2,268	288	322	386	268	268	278
Exports from Union of raw asbestos	do.	5,922	537	454	887	660	483	
Canada:								
Production of asbestos . .	Long ton	251,485	(*d*)22,842	(*d*)22,842	(*d*)22,842			
Exports of asbestos . .	do.	122,098	7,949	7,465	17,246	11,804	9,037	10,176
Exports of asbestos sand (i.e. short fibre) and waste .	do.	108,274	7,979	8,130	7,420	9,457	9,141	9,863
Cyprus:								
Exports of asbestos . .	Long ton	3,204	(*c*)357	(*c*)357	(*c*)357			
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.:								
Imports of raw asbestos and fibre	Long ton	10,663	1,114	1,752	2,730	1,102	1,255	1,081
Exports of raw asbestos and fibre	do.	246	47	18	21	186	153	91
Germany:								
Imports of raw asbestos and fibre	Long ton	11,965	443	319	617	850	756	626
Italy:								
Production of asbestos . .	Long ton	2,071						
Imports of asbestos . .	do.	6,338	614	322	705	464	800	807
Exports of asbestos . .	do.	921	142	70	76	204	179	173
Netherlands:								
Imports of asbestos . .	Long ton	1,286	29	212	41	76	122	44

Russia:								
Production of asbestos rock .	Long ton		5,967					
Production of assorted asbestos	do.	(*b*)10,000	1,656					
United States:								
Total imports of unmanufactured asbestos . . .	Long ton	205,821	23,404	16,194	18,004	19,046	16,789	81,809
BARIUM MINERALS								
BRITISH EMPIRE								
United Kingdom:								
Production of unground barytes and witherite in Great Britain	Long ton	36,336	(*c*)1,927	(*c*)1,927	(*c*)1,927	(*e*)2,832	(*e*)2,832	(*e*)2,832
Production of ground barytes and witherite in Great Britain	do.	12,345	(*c*)1,213	(*c*)1,213	(*c*)1,213	(*e*)1,013	(*e*)1,013	(*e*)1,013
Total imports of ground barytes (*a*)	do.	42,620	3,005	2,933	3,221	3,740	3,291	3,306
Exports of ground barytes (*a*)	do.	3,378	771	23	307	425	108	49
Southern Rhodesia:								
Production of barytes .	Long ton	36	21	—	—	—	—	—
Canada:								
Imports of barytes . .	Long ton	2,173	178	141	125	207	138	97
Australia (Tasmania):								
Production of barytes . .	Long ton	4	—	—	—	—	—	—
FOREIGN COUNTRIES								
Czechoslovakia:								
Imports of crude barytes .	Long ton	3,782	625	311	60	122	349	657
Imports of ground barytes .	do.	3,445	149	255	237	201	184	311

(*a*) *Including precipitated barium sulphate.* (*b*) *Year ended 30th September,* 1925.
(*c*) *Monthly average of second quarter,* 1926. (*d*) *Monthly average of first half-year,* 1926.
(*e*) *Monthly average of third quarter,* 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
BARIUM MINERALS (*contd.*)								
France :								
Imports of barytes . .	Long ton	8,557	923	988	518	428	459	459
Exports of barytes . .	do.	1,563	156	154	154	330	1,395	324
Imports of witherite . .	do.	1,273	50	100	—	—	—	30
Germany :								
Exports of barytes and celestite	Long ton	165,609	11,914	11,059	13,910	10,928	19,011	12,623
Imports of barytes and celestite	do.	2,301	—	—	—	—	—	53
Italy :								
Production of barytes . .	Long ton	31,678						
Netherlands :								
Imports of barytes . .	Long ton	52,360	2,482	1,915	2,364	2,540	2,122	2,366
Russia :								
Production of barytes . .	Long ton		249					
CADMIUM								
Australia :								
Cadmium content of ore produced in Tasmania . .	Lb.	11,750	(*a*)837	(*a*)837	(*a*)837	(*b*)2,947	(*b*)2,947	(*b*)2,947
Cadmium produced in Tasmania from other than Tasmanian ores . . .	do.	388,911	(*a*)26,748	(*a*)26,748	(*a*)26,748	(*b*)25,541	(*b*)25,541	(*b*)25,541
Exports overseas of cadmium from :								
New South Wales . .	do.	71,456	39,760	—	—		—	—
Victoria	do.	219,520	—	—	25,760		29,120	29,120
Tasmania	do.	156,324	—	27,664	12,096		—	3,360
France :								
Imports of cadmium . .	Lb.	171,471	—	30,415	22,481	17,191	3,967	13,224
CHINA CLAY								
EXPORTS FROM BRITISH EMPIRE								
United Kingdom (including Cornish or china stone) . .	Long ton	652,576	44,952	54,377	63,924	80,649	58,138	56,816

29

Exports from Foreign Countries								
Belgium-Luxemburg E.U.	Long ton	7,085	225	311	429	488	642	463
Czechoslovakia	Long ton	236,280	18,652	18,074	19,123	14,574	20,982	17,316
Denmark	Long ton	4,136	—	422	—	5	115	99
France	Long ton	5,209	399	629	528	973	1,668	659
Germany	Long ton	28,455	2,298	3,026	2,458	2,723	3,397	3,244
Russia (production)	Long ton		7,928					
Imports into British Empire								
Canada	Long ton	16,245	1,215	975	1,724	1,775	1,535	1,336
India (total imports from overseas)	Long ton	24,531	2,854	2,275	2,104	2,276	3,229	1,864
Imports into Foreign Countries								
Belgium-Luxemburg E.U.	Long ton	42,535	4,344	4,260	12,925	6,272	5,436	5,685
Czechoslovakia	Long ton	2,291	154	168	168	158	108	360
Denmark	Long ton	5,310	636	82	391	68	1,610	180
France	Long ton	54,737	5,968	4,968	4,582	5,191	5,561	3,543
Germany	Long ton	223,022	17,962	15,311	16,185	21,173	18,323	17,300
Italy	Long ton	39,931	3,007	3,665	2,537	3,158	2,895	3,600
Netherlands	Long ton	46,871	3,574	3,964	6,802	3,099	6,108	3,475
United States (total imports)	Long ton	332,622	17,601	35,750	23,312	42,225	34,553	23,313
CHROME ORE								
British Empire								
Southern Rhodesia:								
Production	Long ton	121,274	4,631	12,417	14,061	22,252	13,293	12,290
Exports	do.	129,866	8,318	12,413	13,881	23,840	12,906	
Union of South Africa:								
Sales and shipments	Long ton	11,137	1,505	1,584	3,443	661	1,035	20
Exports from Union	do.	5,933	971	1,238	2,030	116	1,833	

(a) *Monthly average of second quarter*, 1926. (b) *Monthly average of third quarter*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
CHROME ORE (*contd.*)								
India:								
Exports overseas	Long ton	36,157	7,600	2,390	1,100	2,150	50	1,894
FOREIGN COUNTRIES								
Czechoslovakia:								
Imports	Long ton	1,535	433	209	125	98	89	152
Germany:								
Imports	Long ton	25,468	2,888	1,137	772	4,407	1,841	902
Norway:								
Total imports of chrome ore	£	35,037	6,125	—	—	4,060	2,292	3,413
Exports of ferro-chrome	Long ton	2,486	175	49	63	379	261	49
Russia:								
Production	Long ton		759					
Cuba:								
Production	Long ton	11,655						
United States:								
Total imports	Long ton	149,739	22,532	14,409	8,661	25,762	22,032	24,096
New Caledonia:								
Exports	Long ton	18,208						
COAL								
PRODUCTION OF COAL IN BRITISH EMPIRE								
Great Britain	Long ton	243,176,231	21,567,600	(*e*)	(*e*)	(*e*)	(*e*)	(*e*)
Southern Rhodesia	Long ton	678,320	60,022	67,720	75,411	80,[illegible]5	73,404	73,987
Union of South Africa (*a*)	Long ton	12,127,188	988,426	1,072,738	1,084,378	1,126,076	1,092,000	1,123,399
Canada:								
Bituminous coal	Long ton	7,981,792	740,427	927,191	1,146,351	1,071,952	1,014,213	941,635
Sub-bituminous coal	do.	509,513	18,736	18,897	8,408	17,520	17,137	23,100
Lignite	do.	3,236,345	122,529	72,331	83,670	113,767	161,877	291,225
India (*b*)	Long ton	19,969,041	1,776,104	1,643,846	1,597,300	1,426,462	1,324,719	1,751,368

Australia :								
New South Wales . . .	Long ton	11,396,199						
Western Australia (c) . .	do	37,511	1,208	1,354	7,300	8,733	13,050	£5,272
Tasmania	do	81,698	(d)8,907	(d)8,907	(d)8,907	(g)9,425	(g)9,425	(g)9,425
New Zealand :	Long ton	2,074,975	(f)178,136	(f)178,136	(f)178,136			
PRODUCTION OF COAL IN FOREIGN COUNTRIES								
Austria :								
Coal	Long ton	142,866	13,185	14,670	11,904	6,745	11,741	12,560
Brown coal	do	2,984,627	216,127	212,242	209,009	272,634	218,374	238,893
Belgium	Long ton	22,725,838	1,952,114	1,816,765	2,066,811	2,098,070	2,083,508	2,139,307
Czechoslovakia :								
Coal	Long ton	12,549,474	921,056	886,000	962,505	960,951	1,249,700	1,361,000
Brown coal	do.	18,487,130	1,445,041	1,313,000	1,321,070	1,315,301	1,484,800	1,623,000
France :								
Coal produced in Saar . .	Long ton	12,781,084	1,055,003	1,037,779	1,076,666	1,172,044	1,116,808	1,108,090
Coal produced in other districts	do.	46,291,507	4,049,717	3,803,921	4,275,152	4,227,960	4,219,659	4,230,642
Brown coal	do.	991,082	83,001	74,851	83,633	82,991	83,878	90,893
Germany (excluding Saar) :								
Coal	Long ton	130,490,698	9,923,847	10,506,595	11,567,444	12,863,996	12,672,116	12,668,815
Brown coal	do.	137,479,040	9,905,636	9,734,962	11,022,446	11,297,239	11,237,745	11,525,010
Hungary :								
Coal	Long ton	6,100,000	62,905	59,259	62,303	65,836	65,686	66,184
Brown coal	do.		352,211	343,658	374,524	415,015	439,413	545,448
Italy :								
Anthracite	Long ton	14,072						
Bituminous coal	do.	171,420						
Brown coal	do.	1,087,707						
Netherlands (excluding brown coal)	Long ton	6,738,501	654,000	656,000	712,000	765,000	747,000	758,000
Poland (excluding brown coal) .	Long ton	28,613,134	2,147,290	2,199,009	2,618,005	3,425,905	3,629,000	3,708,436

(a) *Quantity of coal mined less waste sorted.* (b) *Excluding Indian States.*
(c) *Exports from the State, not necessarily overseas, and including bunkers.* (d) *Monthly average of second quarter,* 1926.
(e) *Total imports of coal into United Kingdom were as follows May,* 3,618 *long tons; June,* 600,634 *long tons; July,* 2,319,657 *long tons; August,* 3,970,442 *long tons; September,* 3,940,882 *long tons.* (f) *Monthly average of first half-year.*
(g) *Monthly average of third quarter,* 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
COAL (*contd.*)								
Russia	Long ton	17,398,000	2,127,000	1,806,000	1,960,000	1,999,000	1,882,000	1,915,000
Spain	Long ton	6,415,246						
Algeria	Long ton	9,869	566	608	707	1,028	1,235	
Belgian Congo	Long ton	80,000						
Mexico	Long ton	1,112,000	78,243	74,626	74,704	117,551	137,350	110,162
United States:								
Anthracite	Long ton	55,193,883	7,337,000	7,191,000	7,979,000	7,525,000	7,344,000	7,543,000
Bituminous coal	do.	466,935,000	35,785,000	34,874,000	37,493,000	38,814,000	41,386,000	43,730,000
Chile	Long ton	1,417,275	110,484	116,120	120,662	127,475	123,042	134,190
French Indo-China (exports)	Long ton	690,181	57,587	80,239				
Japan	Long ton	29,000,000						
COBALT								
BRITISH EMPIRE								
Canada:								
Ontario:								
Production of metal	Cwt.	2,693						
Production of oxide	do.	5,139	(*a*)150	(*a*)150	(*a*)150	(*d*)99	(*d*)99	(*d*)99
Dominion:								
Exports of metal	do.	2,616	126	173	138	153	51	245
Exports of oxide and salts	do.	7,794	123	191	192	154	117	124
Australia (Queensland):								
Production of concentrates	Cwt.	1,800	(*a*)7	(*a*)7	(*a*)7	(*d*)30	(*d*)30	(*d*)30
Exports of ore overseas	do.	11,884	1,651	1,060	—		406	—
FOREIGN COUNTRIES								
France:								
Imports of oxide	Cwt.	3,237	2	—	—	—	25	—
Exports of ore	do.	1,035	—	—	—	—	—	—
United States:								
Total imports of ore and metal	Cwt.	1,878	350	130	305	849	356	997
Total imports of oxide	do.	2,565	219	163	241	406	45	94

COPPER								
British Empire								
United Kingdom:								
Total imports of ore, regulus, matte, cement-copper and scale	Long ton	36,730	2,738	5,319	1,706	1,912	3,542	617
Total imports of unwrought copper	do.	144,077	10,879	6,936	10,929	10,895	11,008	8,918
Re-exports of unwrought copper	do.	6,860	239	159	866	804	435	505
Exports of unwrought copper	do.	4,429	538	503	430	1,269	1,660	4,096
Total imports of wrought copper	do.	22,346	932	793	1,115	1,491	1,162	1,259
Exports of wrought copper .	do.	20,848	1,558	1,332	1,351	1,391	1,636	1,935
Northern Rhodesia:								
Smelter output . . .	Long ton	(b)66	—	—	—	—	—	—
Southern Rhodesia:								
Smelter output . . .	Long ton	1,686	(c)8	—	—	—	—	—
South-West Africa Territory:								
Exports of copper ore . .	Long ton	53,401	4,503	28	4,622	3,827	3,049	
Union of South Africa:								
Copper content of marketable products:								
Transvaal . . .	Long ton	5,482	531	495	400	503	—	—
Cape of Good Hope . .	do.	2,614	237	238	256	272	293	303
Canada:								
Copper content of ore produced in the Dominion . .	Long ton	49,755	(e)5,271	(e)5,271	(e)5,271			
Copper content of matte exported from Ontario .	do.	8,963	(a)738	(a)738	(a)738	(d)895	(d)895	(d)895
Smelter output in the Dominion	do.	24,735	2,932	2,686	1,597	2,613	2,805	2,321
Exports from the Dominion:								
Copper content of ore, matte and regulus . . .	do.	27,021	263	3,551	2,433	2,817	3,074	1,778
Blister copper . . .	do.	21,678	1,544	1,251	416	3,326	1,958	1,665
Unwrought copper and scrap	do.	2,502	168	189	218	397	215	260

(a) *Monthly average of second quarter*, 1926. (b) *Including an adjustment for the period* 1920-24 *inclusive*. (c) *Including an adjustment*. (d) *Monthly average of third quarter*, 1926. (e) *Monthly average of first half-year*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
COPPER (*contd.*)								
Canada (*contd.*)								
Imports into the Dominion :								
Unwrought copper and scrap	Long ton	5,403	245	471	703	380	426	451
Wrought copper . .	do.	13,704	670	465	931	1,223	791	917
India :								
Production of matte in Burma	Long ton	8,029	(*a*)887	(*a*)887	(*a*)887			
Australia :								
Queensland :								
Copper content of ore produced	Long ton	3,909	(*a*)76	(*a*)76	(*a*)76	(*b*)125	(*b*)125	(*b*)125
Tasmania :								
Copper content of ore produced	Long ton	6,539	(*a*)504	(*a*)504	(*a*)504	(*b*)649	(*b*)649	(*b*)649
Commonwealth :								
Output of blister copper .	Long ton	10,984	—	626	1,312	482	202	1,089
Value of matte and ingots exported . . .	£	242,366	42,300	29,245	8,265	29,225	34,009	10,178
FOREIGN COUNTRIES								
Austria :								
Production of ore . . .	Long ton	79,332	6,154	7,338	8,716	9,014	8,094	8,170
Belgium-Luxemburg E.U. :								
Imports of ore . . .	Long ton	45,382	8,459	6,987	28,359	2,293	172	463
Imports of unwrought copper	do.	22,710	1,316	3,008	6,362	693	3,742	1,245
Exports of unwrought copper	do.	12,244	1,085	1,189	1,745	809	851	1,094
Imports of wrought copper .	do.	5,666	428	548	558	315	387	509
Exports of wrought copper .	do.	4,777	268	188	222	31[illegible]	281	264
Czechoslovakia :								
Exports of ore . . .	Long ton	212	131	78	17	—	340	—
Imports of unwrought copper and scrap	do.	16,111	1,780	1,125	1,021	1,003	1,454	1,812
Exports of unwrought copper and scrap	do.	2,668	212	103	317	227	185	573

France :								
Production of ore . . .	Long ton	2,735	2,027	1,154	1,153	1,151		
Germany :								
Imports of ore, matte and calcined cupreous pyrites .	Long ton	84,863	10,855	12,504	9,740	9,164	15,998	4,786
Exports of ore, matte and calcined cupreous pyrites .	do.	20,773	1,977	4,653	5,218	—	8,493	1,463
Imports of unwrought copper	do.	207,567	10,818	9,600	13,275	12,421	13,116	13,960
Exports of unwrought copper	do.	17,635	1,897	1,567	2,150	1,567	2,110	1,811
Imports of wrought copper .	do.	447	30	47	43	31	34	53
Exports of wrought copper .	do.	29,018	4,104	2,953	2,997	3,539	3,272	3,998
Italy :								
Production of ore . . .	Long ton	9,957						
Smelter production . .	do.	1,059						
Netherlands :								
Total imports of unwrought and wrought copper and scrap .	Long ton	9,010	794	840	724	727	722	773
Re-exports of unwrought and wrought copper and scrap .	do.	5,928	241	163	451	95	614	271
Spain :								
Copper content of ore produced	Long ton	30,000						
Algeria :								
Production of ore . . .	Long ton	1,722	182	171	165	191	243	
Belgian Congo :								
Smelter output . . .	Long ton	88,656	6,436	6,884	6,642	6,891	7,327	6,808
Cuba :								
Copper content of ore produced	Long ton	10,592						
Mexico :								
Copper content of ore produced	Long ton	50,511	5,535	4,606	5,369	2,514	2,978	4,557
Smelter output . . .	do.	32,365	3,373	3,113	3,359	3,154	2,952	2,927
United States :								
Copper content of total imports of ore, concentrates, matte and regulus . . .	Long ton	72,915	3,051	7,486	3,382	8,950	3,882	8,550

(a) *Monthly average of second quarter*, 1926. (b) *Monthly average of third quarter*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
COPPER (*contd.*)								
United States (*contd.*):								
Primary copper obtained from U.S. mines	Long ton	751,900	65,584	65,663	63,675	64,489	64,298	64,087
Smelter output	do.	845,833	76,742	75,915	68,898	68,285	69,297	71,714
Total imports of unrefined copper	do.	169,345	23,087	14,338	17,670	18,020	12,936	24,687
Total imports of refined copper	do.	44,542	4,573	5,650	6,392	3,847	4,534	5,936
Exports of refined copper	do.	432,172	37,466	29,770	34,544	28,245	30,896	31,489
Total imports of scrap	do.	4,655	841	291	447	665	431	242
Exports of scrap	do.	5,404	406	960	902	491	662	764
Exports of wrought copper	do.	11,899	2,240	1,648	2,430	1,874	2,140	3,390
Bolivia:								
Exports of ore	Long ton	14,423	1,201	1,467	2,069	1,588	1,551	1,789
Copper content of ore exported	*do.*		*525*	*647*	*954*	*724*	*610*	*635*
Chile:								
Exports of ore	Long ton	77,921	702	3,359	—	14,681	6,358	15,028
Production of copper bar	do.	173,166	14,299	15,209	13,893	13,398	14,008	15,006
Exports of copper bar	do.	153,820	16,125	15,794	11,037	22,202	5,745	21,116
Peru:								
Smelter output	Long ton	38,400	3,427	3,287	3,001	3,057	3,404	3,101
Exports of ore (*a*)	do.	922	117	797	65		128	65
Exports of matte (*a*)	do.	951	—	46	—		—	—
Exports of concentrates (*a*)	do.	554	—	56	38		43	27
Exports of bars	do.	36,208	3,176	5,285	1,251		288	4,757
Japan:								
Smelter output	Long ton	64,656	5,644	5,795	5,433	5,408	5,423	5,260
DIAMONDS								
BRITISH EMPIRE								
Gold Coast:								
Exports	Metric carat	77,314	1,106	18,135	17,795	49,115	28,755	
Southern Rhodesia:								
Production	Metric carat	189	—	—	—	—	—	—
Exports	do.	292	—	—	37	—	—	

South-West Africa Territory :								
Exports	Metric carat	515,090	49,484	59,798	59,410	57,574	55,335	
Union of South Africa :								
Production	Metric carat	2,430,128	208,231	226,057	236,821	270,029	275,613	338,851
Exports	do.	2,591,239	194,255	226,708	159,951	324,724	135,367	
Canada :								
Imports of unset diamonds	£	587,693	15,401	75,002	73,073	22,009	45,837	55,681
Imports of diamond dust or bort and black diamonds for borers	£	107,869	25,915	26,059	8,446	28,560	6,353	28,140
British Guiana :								
Exports	Metric carat	198,297	15,490	4,426	12,300	17,163	6,029	18,650
Ceylon :								
Imports	Metric carat	1,052	£49	£129	1,591	1,099	—	—
India :								
Total imports from overseas	£	536,285	22,227	38,053	49,033	23,216	38,622	31,300
FOREIGN COUNTRIES								
United States :								
Total imports of unset diamonds for glaziers, engravers and miners	Metric carat	46,556	2,854	2,783	1,561	2,133	2,936	6,809
Total imports of uncut diamonds	do	171,842	16,297	11,382	15,839	30,129	19,207	15,936
Total imports of cut diamonds, unset	do.	513,783	32,490	40,947	37,903	45,748	44,729	52,172
Total imports of diamond dust	£	157,481	6,890	7,942	6,942	3,330	733	3,802
GOLD								
PRODUCTION IN BRITISH EMPIRE								
Anglo-Egyptian Sudan (exports of bullion)	Troy oz.	8,745	561	549	642	646	—	1,636
Gold Coast	Fine troy oz.	190,930	13,848	14,418	13,990	14,423		
Northern Rhodesia	Fine troy oz.	1,250	1	91	—	126	—	141

(a) *Copper is also contained in mixed ores, etc., exported.*

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
GOLD (*contd.*)								
Southern Rhodesia	Fine troy oz.	581,504	51,928	49,392	52,381	50,460	49,735	48,350
Swaziland	Troy oz.	1,309						
Union of South Africa :								
Total production	Fine troy oz.	9,597,592	803,265	846,761	847,537	860,808	843,409	841,103
By districts :								
Witwatersrand	do.	9,341,048	778,939	821,697	822,436	835,441	818,671	815,868
Other Transvaal	do.	256,525	24,326	25,064	25,101	25,367	24,738	25,235
Natal	do.	19	—	—	—	—	—	—
Canada (Ontario) :								
Total crude bullion produced (*a*)	Troy oz.	(*b*) 1,465,774	134,867	123,695	122,780	109,483	129,180	128,343
By districts :								
Porcupine	do.	1,204,040	104,979	92,867	95,412	83,017	98,318	98,647
Kirkland Lake	do.	261,473	29,859	30,739	27,339	26,466	30,862	29,696
Miscellaneous	do.	261	29	89	29	—	—	—
British Guiana (exports)	Troy oz.	6,974	722	—	1,248	577	—	669
Federated Malay States :								
Pahang (exports)	Troy oz.	12,496	904	831	1,740	1,072	1,105	1,146
Perak	do.	1,659	137	164	164	47	143	173
India	Fine troy oz.	393,800	31,453	32,188	31,797	32,416	32,240	
Australia :								
New South Wales	Fine troy oz.	19,422	2,562	536	939			
Victoria	do.	47,296	3,870	4,297	4,943	4,876	4,382	3,771
Queensland	do.	44,332	663	1,393	906	503	771	418
Western Australia	do.	441,252	43,695	35,438	39,682	35,116	40,893	33,144
Tasmania	do.	3,524	(*c*) 219	(*c*) 219	(*c*) 219	(*e*) 352	(*e*) 352	(*e*) 352
Commonwealth	do.	556,000						
New Zealand (exports)	Troy oz.	114,669	10,492	8,800	13,712	6,089	9,280	16,980
PRODUCTION IN FOREIGN COUNTRIES								
France (gold ores)	Long ton	56,709	5,559	5,746	6,100	6,420	6,361	5,771
Italy	Troy oz.	2,205						

Russia	Fine troy oz.	734,400						
Belgian Congo (Kilo Moto only)	Troy oz.	115,901	(d)9,574	(d)9,574	(d)9,574			
Madagascar (exports)	Troy oz.	6,336	400	230	262	214		
Mexico	Fine troy oz.	788,993	68,254	59,767	70,023	57,323	56,263	55,202
United States	Fine troy oz.	2,319,920						
Bolivia :								
Quantity of gold exported	Troy oz.	386	—	—	—	—	—	—
Value of gold exported	£	1,274	—	—	—	—	—	—
Brazil	Fine troy oz.	120,330						
Ecuador	Fine troy oz.	43,000						
Japan	Fine troy oz.	280,000						
Philippine Islands (exports of bullion)	Troy oz.	159,580	15,963	12,641	10,659	15,421	11,722	13,318
GYPSUM								
BRITISH EMPIRE								
Canada :								
Production of gypsum	Long ton	661,003	(d)74,5?5	(d)74,515	(d)74,515			
Exports of crude gypsum	do.	476,469	—	—	86,161	69,911	76,114	72,149
Imports of crude gypsum	do.	3,958	75	3	91	6	93	1
Imports of ground gypsum	do.	105	6	29	(1 cwt.)	2	27	18
Exports of plaster of Paris, etc.	do.	5,038	418	627	362	437	471	394
Imports of plaster of Paris, etc.	do.	3,902	218	339	298	585	697	641
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Exports of crude gypsum	Long ton	2,892	1,264	1,493	1,240	741	140	133
Imports of crude gypsum	do.	85,644	13,039	11,234	8,873	12,418	16,470	9,825
Exports of ground gypsum	do.	7,623	357	499	459	272	520	459
Imports of ground gypsum	do.	32,774	2,603	3,174	3,689	3,037	4,184	4,482
Czechoslovakia :								
Imports of crude gypsum	Long ton	18,040	1,292	1,968	1,789	1,910	1,353	2,195
Imports of calcined gypsum	do.	32,148	3,324	3,424	3,356	3,187	3,128	3,862

(a) *Including a small quantity of silver.* (b) *Gold content of ore produced in the Dominion during* 1925 *was* 1,735,735 *fine troy ounces.*
(c) *Monthly average of second quarter,* 1926. (d) *Monthly average of first half-year,* 1926.
(e) *Monthly average of third quarter,* 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
GYPSUM (*contd.*)								
France:								
Exports of plaster of Paris	Long ton	206,425	21,800	19,095	24,858	20,887	29,357	25,879
Imports of plaster of Paris	do.	13,912	897	2,085	1,720	745	753	396
Germany:								
Exports of gypsum and gypsum-superphosphate	Long ton	109,021	9,683	9,624	9,549	8,648	10,071	8,270
Imports of gypsum and gypsum-superphosphate	do.	7,473	638	660	741	558	972	909
Italy:								
Exports of gypsum	Long ton	1,186	39	118	207	190	158	102
Imports of gypsum	do.	3,078	141	274	268	193	171	161
Production of gypsum and alabaster	do.	662,707						
Exports of crude alabaster	do.	2,922	152	101	137	157	161	221
Netherlands:								
Imports of gypsum	Long ton	18,782	2,042	2,322	1,603	2,097	1,633	1,129
United States:								
Total imports of crude gypsum	Long ton	566,449	25,856	72,244	104,813	95,392	79,007	86,403
IRON ORE								
BRITISH EMPIRE								
United Kingdom:								
Total production in Great Britain	Long ton	10,142,855	(b)365,220	(b)365,220	(b)365,220	(c)42,978	(c)42,978	(c)42,978
By kinds:								
West coast haematite (non-phosphoric)	do.	951,873	(b)40,189	(b)40,189	(b)40,189	(c)13,440	(c)13,440	(c)13,440
Jurassic ironstones:								
Lower Lias	do.	1,988,268	(b)78,483	(b)78,483	(b)78,483	(c)26[illegible]	(c)260	(c)260
Middle Lias: Cleveland	do.	2,284,186	(b)77,062	(b)77,062	(b)77,062	(c)21,383	(c)21,383	(c)21,383
Other	do.	1,527,400	(b)52,261	(b)52,261	(b)52,261	(c)1,285	(c)1,285	(c)1,285
Inferior Oolite	do.	2,948,413	(b)106,700	(b)106,700	(b)106,700	(c)5,875	(c)5,875	(c)5,875
Coal measure ironstones	do.	342,998	(b)7,565	(b)7,565	(b)7,565	(c)730	(c)730	(c)730
Other haematite, brown ore, etc.	do.	99,717	(b)2,960	(b)2,960	(b)2,960	(c)5	(c)5	(c)5

Total imports . . .	do.	4,381,907	418,882	191,501	68,250	35,809	29,499	14,487
Exports	do.	2,582	111	1,313	1,209	336	1,127	854
Southern Rhodesia :								
Production	Long ton	1,046	234	235	763	—	—	—
Union of South Africa :								
Production	Long ton	—	1,282	1,518	2,471	5,678	6,721	6,862
Canada :								
Imports	Long ton	926,094	1,920	35,631	167,026	238,075	248,815	230,417
Exports	do.	3,932	40	—	36	36	161	99
British Malaya :								
Exports	Long ton	271,995	8,802	33,426	19,545	23,733	23,522	27,122
Australia (Queensland) :								
Production	Long ton	(*a*)303	(*b*)503	(*b*)503	(*b*)503			
FOREIGN COUNTRIES								
Austria :								
Production :								
Styria and Carinthia . .	Long ton	1,008,561	96,054	97,027	91,343	77,761	82,175	79,107
Salzburg	do.		—	—	—	1,068	1,118	1,513
Belgium-Luxemburg E.U. :								
Imports	Long ton	8,744,363	988,014	683,730	894,148	921,897	905,229	915,704
Exports	do.	1,763,644	113,007	75,811	79,175	103,442	96,371	107,744
Czechoslovakia :								
Imports	Long ton	812,950	19,761	56,037	96,332	87,715	55,444	189,867
Exports	do.	81,030	11,112	15,947	14,410	17,504	13,848	13,542
France :								
Total extracted . . .	Long ton	35,166,783	2,932,034	2,975,757	3,288,325	3,256,081	3,252,473	3,261,608
Of which, merchantable ore :								
Non-phosphoric . .	do.	241,805	19,850	21,373	19,249	21,531	21,380	19,025
Slightly phosphoric . .	do.	1,482,746	141,556	134,535	150,212	148,670	148,197	156,521
Phosphoric . . .	do.	33,158,521	2,759,696	2,805,260	3,099,981	3,067,969	3,066,555	3,070,889
Exports	do.	9,078,408	864,460	939,610	895,126	945,308	945,509	924,596
Imports	do.	1,218,141	87,691	75,554	187,924	107,182	143,607	146,054

(*a*) *Iron ore produced in the Commonwealth during* 1925 *was* 738,686 *long tons.* (*b*) *Monthly average of second quarter,* 1926.
(*c*) *Monthly average of third quarter,* 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
IRON ORE (*contd.*)								
Germany:								
Imports	Long ton	11,354,546	703,268	709,038	726,539	739,445	711,796	923,631
Exports	do.	198,500	9,045	13,124	11,087	12,966	19,987	12,687
Hungary:								
Production	Long ton	66,968	9,792	11,126	10,315			
Italy:								
Production	Long ton	505,001						
Imports	do.	304,314	32,209	28,410	24,524	19,919	17,316	13,588
Luxemburg:								
Production	Long ton	6,564,862						
Norway:								
Exports	Long ton	417,836	14,754	2,322	—	—	—	—
Poland:								
Production	Long ton			21,907	26,527	30,372	31,164	31,559
Russia:								
Production	Long ton	(c)2,160,904	264,505					
Sweden:								
Exports	Long ton	8,658,932	511,222	538,969	675,967	665,475	759,770	836,112
Switzerland:								
Exports	Long ton	58,573	1,807	3,184	5,467	5,930	7,760	6,214
Imports	do.	41,751	2,691	5,632	8,380	7,171	4,252	2,419
Algeria:								
Total extracted	Long ton	1,772,228	160,890	141,560	130,873	115,197	126,740	
Of which, merchantable ore:								
Non-phosphoric	do.	1,731,690	154,918	135,518	124,710	108,703	121,379	
Slightly phosphoric	do.	25,666	4,804	4,462	4,809	5,069	5,401	
Tunis:								
Production (all non-phosphoric)	Long ton	711,000	50,000	43,000	42,000	46,000	41,000	
Cuba:								
Production	Long ton	900,000						
United States:								
Production	Long ton	(a)63,328,517						
Shipments from mines through Upper Lake Ports	do.	54,075,000	10,000	6,113,000	8,770,000	9,999,000	10,709,000	9,622,000

Total imports	do.	2,190,697	194,731	238,678	272,449	232,847	259,151	232,360
Exports	do.	630,700	2,022	77,384	105,387	186,315	228,367	100,778
Chile :								
Exports	Long ton	1,214,260	245,283	99,437	118,349	125,546	158,312	110,607
LEAD								
BRITISH EMPIRE								
United Kingdom :								
Lead content of ore produced in Great Britain . . .	Long ton	12,463	(*d*)1,328	(*d*)1,328	(*d*)1,328	(*e*)1,171	(*e*)1,171	(*e*)1,171
Smelter output . . .	do.	4,735	(*b*)326	(*b*)326	(*b*)326			
Total imports of pig-lead and sheet	do.	275,072	30,652	18,752	18,741	16,980	19,863	25,484
Re-exports of pig-lead and sheet	do.	14,573	844	49	1,201	1,682	911	3
Exports of pig-lead . .	do.	6,380	401	270	421	372	493	424
Exports of wrought lead .	do	6,611	625	595	437	531	430	515
Northern Rhodesia :								
Smelter output . . .	Long ton	2,993	—	—	246	595	646	579
Exports of pig-lead . .	do.	3,645	92	—	1	416	129	
Southern Rhodesia :								
Lead content of ore produced .	Long ton	4	—	—	—	—	—	—
South-West Africa Territory :								
Exports of pig-lead . .	Long ton	1,525	—	—	—	602	—	
Union of South Africa :								
Lead content of sales and shipments of ore :								
Transvaal . . .	Long ton	1,602	3	10	6	3	5	8
Cape of Good Hope . .	do.	127	7	14	9	6	7	7
Canada :								
Lead content of ore produced .	Long ton	113,210	(*b*)10,297	(*b*)10,297	(*b*)10,297			
Lead content of ore exported .	do.	16,743	—	112	1,533	1,056	1,664	880
Smelter output . . .	do.	110,962	9,395	11,354	11,020	9,977	10,124	11,499
Exports of pig-lead . .	do.	71,487	5,108	7,982	6,697	9,060	7,292	6,390

(*a*) *Including ore containing up to* 35 *per cent. of manganese.*
(*b*) *Monthly average of first half-year,* 1926.
(*c*) *Year ended* 30*th September,* 1925.
(*d*) *Monthly average of second quarter,* 1926.
(*c*) *Monthly average of third quarter,* 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
LEAD (*contd.*)								
India :								
Lead content of ore produced in Burma	Long ton	66,600	(*a*)6,009	(*a*)6,009	(*a*)6,009			
Refinery output in Burma .	do.	47,665	(*a*)4,739	(*a*)4,739	(*a*)4,739	4,279	3,970	4,363
Exports of pig-lead overseas .	do.	41,137	3,452	3,620	3,872	1,947	4,597	2,500
Total imports of wrought lead from overseas . . .	do.	2,394	241	175	189	90	107	229
Australia :								
Lead content of ore produced in (*b*) :								
Queensland . . .	Long ton	4,836	(*a*)386	(*a*)386	(*a*)386	(*c*)319	(*c*)319	(*c*)319
Tasmania	do.	5,526	(*a*)464	(*a*)464	(*a*)464	(*c*)588	(*c*)588	(*c*)588
Exports of ore and concentrates overseas from :								
Victoria (ore) . . .	do.	86	—	—	—		—	—
Western Australia (concentrates)	do.	4,823	936	319	—		729	364
South Australia (concentrates)	do.	29,877	—	1,007	413		10	—
Exports of silver-lead ore and concentrates overseas from :								
New South Wales . .	do.	986	415	341	237		484	236
Western Australia . .	do.	87	69	—	—		—	16
Queensland . . .	do.	1,162	42	16	10		—	—
South Australia . .	do.	770	12	—	63		—	—
Tasmania	do.	7,117	931	—	805		—	—
Smelter output in Commonwealth	do.	148,880	10,858	13,043	13,769	13,413 £	14,601	13,290
Exports overseas of pig-lead from :								
New South Wales . .	do.	73,796	5,264	6,307	4,718		6,339	11,552
Queensland (silver-lead bullion)	do.	3,037	547	570	500		—	—
South Australia . .	do	43,652	891	998	8,591		4,002	2,004

Value of matte and pig-lead exported from Commonwealth	£	4,718,275	173,103	194,419	408,642	417,636	351,748	482,069
FOREIGN COUNTRIES								
Austria :								
Carinthia :								
Production of lead ore	Long ton	5,527	779	598	691	635	684	630
Smelter output	do.	5,322	596	825	396	459	540	650
Tyrol : Production of lead ore	do.	7,424	678	670	674	678	394	—
Belgium-Luxemburg E.U. :								
Imports of ore	Long ton	34,030	3,806	4,059	14,314	3,797	1,636	3,176
Exports of ore	do.	396	6	14	27	30	158	1
Imports of pig-lead and scrap	do.	11,140	1,192	1,406	2,534	1,120	1,179	2,294
Exports of pig-lead and scrap	do.	14,376	2,426	1,957	2,025	1,737	3,047	2,710
Imports of wrought lead, etc.	do.	1,103	30	18	13	27	10	13
Exports of wrought lead, etc.	do.	9,681	924	661	1,235	1,061	1,010	897
Czechoslovakia :								
Imports of pig-lead and scrap	Long ton	5,994	645	438	496	618	973	653
France :								
Production of lead ore	Long ton	16,417	974	886	884	521	741	1,188
Production of lead-zinc ore	do.		1,328	1,558	1,533	1,476	1,859	1,866
Imports of ore	do.	30,400	2,918	2,014	3,503	2,733	278	4,847
Exports of ore	do.	8,623	474	172	674	764	995	174
Imports of pig-lead and scrap	do.	70,325	7,969	4,341	8,626	6,892	5,796	4,027
Exports of pig-lead and scrap	do.	2,849	55	174	88	82	164	325
Germany :								
Imports of ore	Long ton	34,705	3,020	4,730	4,171	4,412	6,149	2,901
Exports of ore	do.	7,174	486	792	1,496	1,014	1,489	1,457
Smelter output	do.	46,000				5,784	6,400	7,000
Imports of pig-lead and scrap	do.	135,531	4,998	6,956	7,209	7,261	8,090	9,818
Exports of pig-lead and scrap	do.	15,087	1,226	1,194	1,516	1,663	1,519	1,414
Exports of wrought lead	do.	3,545	74	626	842	746	838	568

(a) *Monthly average of second quarter*, 1926. (b) *Lead content of ore produced in the Commonwealth during* 1925 *was* 184,606 *long tons.*
(c) *Monthly average of third quarter*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
LEAD (*contd.*)								
Italy:								
Lead content of ore produced	Long ton	28,225						
Imports of ore, including argentiferous	do.	6,980	1,201	33	703	1,606	40	17
Exports of ore, including argentiferous	do.	12,519	9	2,682	371	475	3,240	973
Smelter output	do.	24,081	827	2,071	2,317	2,413	1,895	1,913
Imports of pig-lead and scrap (*a*)	do.	26,183	1,699	1,703	1,208	2,243	3,125	1,203
Exports of pig-lead and scrap (*a*)	do.	8,532	3	3	12	3	21	17
Netherlands:								
Imports of pig-lead and scrap .	Long ton	11,875	939	1,722	1,806	1,054	1,454	1,608
Imports of wrought lead .	do.	3,657	210	232	342	399	337	142
Russia:								
Production of lead-zinc ore .	Long ton		2,770					
Production of lead concentrates	do		187					
Spain and Tunis (*b*):								
Smelter output . . .	Long ton	114,680	10,030	8,633	9,685	10,993	10,513	10,596
Upper Silesia:								
Production of ore . . .	Long ton	19,013						
Smelter production . .	do.	20,980	2,259	2,204	2,400	2,100	2,100	2,100
Algeria:								
Production of ore . . .	Long ton	15,369	1,211	927	754	842	778	
Tunis:								
Production of ore (see Spain)	Long ton	36,494	2,971	2,863	3,011	2,411	2,529	
Mexico:								
Lead content of ore produced	Long ton	169,007	13,997	16,052	14,483	20,1[illegible]7	18,735	17,404
Smelter output (*c*) . .	do.	181,500	20,843	17,354	17,437	17,943	17,017	16,069
United States:								
Lead content of ore produced .	Long ton	609,068	47,291	52,659	46,472	50,455	51,849	54,137
Smelter output (*d*) . .	do.	654,888	41,712	44,567	42,432	42,675	41,498	44,491
Lead content of total imports of:								
Ore and matte . . .	do.	39,715	3,029	3,516	1,700	7,158	4,318	5,095

Bullion and base bullion	do.	63,059	7,059	7,609	5,568	8,754	3,887	9,823
Pig-lead and bars	do.	5,713	503	250	400	2,155	959	539
Scrap and alloys	do.	556	51	83	128	114	66	72
Type metal and antimonial lead	do.	1,924	383	9	149	184	86	129
Exports of pig-lead, bars, etc., produced from:								
Domestic ore	do.	4,425	1,659	31	94	73	21	48
Foreign ore	do.	87,428	4,219	4,129	7,295	6,812	5,092	4,899
Argentina:								
Smelter output	Long ton	7,700						
Bolivia:								
Exports of ore, etc.	Long ton	36,246	2,518	2,006	1,645	2,070	2,081	2,828
Lead content of ore, etc., exported	*do*		*1,536*	*1,134*	*983*	*1,291*	*1,358*	*1,705*
MANGANESE ORE								
British Empire								
United Kingdom:								
Total imports	Long ton	278,647	23,124	13,016	24,120	10,828	4,439	7,247
Re-exports	do.	1,370	5	—	—	18	154	43
Gold Coast:								
Exports	Long ton	338,657	21,667	39,588	33,041	36,196	28,078	
Union of South Africa (Transvaal):								
Sales and shipments	Long ton	448	101	71	36	—	156	86
Canada:								
Exports	Long ton	434	—	—	62	38	29	34

(a) *Including antimonial lead.*
(b) *Incomplete figures.*
(c) *Including lead produced in the United States from Mexican ore, which averaged 2,500 long tons per month during 1924.*
(d) *Monthly figures exclude lead produced from Mexican ore.*

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
MANGANESE ORE (*contd.*)								
India :								
Exports overseas	Long ton	604,198	48,328	38,720	42,880	31,480	38,175	45,109
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U. :								
Imports	Long ton	196,895	16,817	29,753	23,910	25,222	15,800	31,076
Czechoslovakia :								
Imports	Long ton	668	205	—	54	75	—	—
France :								
Production	Long ton	3,134	148	—	199	246	241	241
Imports	do.	462,015	35,274	67,832	38,111	57,996	59,159	67,621
Exports	do.	1,696	43	74	159	104	164	152
Germany :								
Imports	Long ton	196,171	14,958	18,019	11,308	21,955	10,659	5,334
Exports	do.	360	129	2	—	—	76	1,178
Italy :								
Production	Long ton	14,743						
Imports	do.	67,659	584	3,102	14,354	8,344	270	4,327
Exports	do.	2,553	172	173	217	280	344	693
Russia (*b*) **:**								
Production of crude ore (*a*)	Long ton		72,430					
Production of washed ore (*a*)	do.		41,789					
Tunis :								
Production	Long ton	1,702	103	118	103	110	141	
United States :								
Imports of ore	Long ton	12,475	90	29	13	200	3,785	4,814
Manganese content of other ores imported (*c*)	do.	278,917	55,047	21,633	31,315	34,133	41,075	18,167
Brazil :								
Exports	Long ton	306,870	7,214	23,358	41,086	38,780	27,680	

MICA								
BRITISH EMPIRE								
United Kingdom :								
Total imports	Long ton	2,693	240	166	213	238	229	235
Re-exports	do.	1,383	73	32	116	122	63	30
Southern Rhodesia :								
Production	Long ton	130	15	5	21	17	20	14
Exports	do.	195	22	21	16	6	19	
Union of South Africa :								
Production	Long ton	1,054	101	100	83	101	110	47
Exports	do.	839	—	9	—	—	—	
Canada (*d*) **:**								
Exports of :								
Scrap and waste . .	Long ton	4,457	64	250	513	464	438	419
Rough cobbed and thumb-trimmed mica . .	do.	25	2	2	4	2	(*e*)	6
Splittings	do.	206	45	23	11	13	15	35
India :								
Exports of blocks overseas .	Long ton	748	43	49	112	92	52	63
Exports of splittings overseas	do.	4,237	356	343	573	273	282	221
FOREIGN COUNTRIES								
Germany :								
Imports	Long ton	1,223	53	47	158	24	43	35
France :								
Imports	Long ton	736	47	75	36	61	56	27
Exports	do.	402	11	13	43	27	10	59
Madagascar :								
Exports of muscovite . .	Long ton	36	4	9	(*e*)	1		
Exports of phlogopite, etc. .	do.	226	12	1	66	35		
United States :								
Exports	Long ton	1,081	133	87	33	72	204	39
Imports	do.	280	31	16	43	42	45	26

(*a*) *Excluding Tchiaturi.* (*b*) *Production of manganese ore in Russia during the year ended 30th September, 1925, was 512,721 long tons.* (*c*) *Additional to previous item.* (*d*) *Production of mica during 1925 was 3,153 long tons.* (*e*) *Less than ½ ton.*

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
NICKEL								
BRITISH EMPIRE								
Canada:								
Production in Ontario:								
Nickel in matte exported	Long ton	14,637	(a)1,018	(a)1,018	(a)1,018	(b)1,381	(b)1,381	(b)1,381
Nickel	do.	14,275	(a) 885	(a) 885	(a) 885	(b)615	(b)615	(b)615
Nickel oxide	do.	4,059	(a) 492	(a) 492	(a) 492	(b)279	(b)279	(b)279
Exports:								
Nickel content of ore, matte or speiss	do.	17,950	362	2,015	1,394	1,747	1,519	627
Nickel	do	13,445	1,008	548	823	812	872	802
Imports of nickel and nickel-silver	do.	473	22	54	51	102	10	18
India:								
Total imports of nickel and alloys from overseas	Long ton	969	69	72	99	57	63	92
FOREIGN COUNTRIES								
Belgium-Luxemburg E.U.:								
Imports of wrought nickel	Long ton	442	11	29	18	20	14	17
Exports of wrought nickel	do.	1,446	153	152	113	65	28	140
Imports of unwrought nickel and scrap	do.	2,617	330	53	350	3	269	73
Exports of unwrought nickel and scrap	do	584	60	44	16	48	175	137
France:								
Imports of ore, matte and speiss	Long ton	1,548	—	23	308	394	—	295
Imports of nickel and nickel-silver	do.	901	158	197	116	79	445	179
Exports of nickel and nickel-silver	do.	514	44	8	10	7	8	6

Germany:								
Imports of ore	Long ton	2,753	32	205	52	88	65	3
Imports of unwrought nickel, scrap and coin	do	2,481	250	140	86	97	124	158
Exports of unwrought nickel, scrap and coin	do.	659	28	57	69	47	75	49
Netherlands:								
Imports of unwrought and wrought nickel, etc	Long ton	508	56	44	63	38	54	39
United States:								
Total imports of ore and matte	Long ton	4,425	395	—	576	562	423	558
Total imports of nickel and nickel-silver	do.	14,302	1,394	1,897	794	726	988	757
Exports of nickel-silver	do.	220	111	39	40	61	19	38
New Caledonia:								
Exports of ore	Long ton	12						
Exports of matte	do.	4,364						
PETROLEUM (INCLUDING SHALE-OIL)								
BRITISH EMPIRE								
Trinidad:								
Production	Long ton	626,644	56,790	63.779	57,823	60,549	63,434	54,643
Exports:								
Crude petroleum	Gallon	10,513,048	920	1,080	1,532	1,040	1,124,247	1,001,280
Gasoline	do.	13,425,650	1,199,995	2,096,135	2,066,935	2,052,334	318,417	2,558,222
Kerosene	do.	2,735,831	76,243	60,596	43,754	44,211	91,355	93,892
Fuel-oil	do.	99,525,178	3,578,768	7,790,839	11,118,901	9,057,702	12,810,929	6,010,975
Lubricating oil	do.	28,064	308	258	512	—	540	1,148
India:								
Production	Long ton	1,182,068						
Exports overseas:								
Benzine and other light oils	Gallon	12,822,072	—	—	2,218,496	—	—	—
Other mineral oils	do.	137,242	4,693	8,955	5,516	12,629	19,463	6,802

(*a*) *Monthly average of second quarter*, 1926.   (*b*) *Monthly average of third quarter*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
PETROLEUM (INCLUDING SHALE-OIL) (*contd.*)								
Sarawak :								
Production	Long ton	603,270						
FOREIGN COUNTRIES								
France :								
Production	Long ton	67,753	6,356	5,500	5,440	5,618	6,089	6,341
Germany :								
Production	Long ton	77,833						
Italy :								
Production	Long ton	5,067						
Poland :								
Production	Long ton	798,862	67,121	68,190	66,000	67,538	66,235	63,040
Rumania :								
Total production . . .	Long ton	2,274,535	239,520	279,265	276,392	293,561	280,782	292,267
By fields :								
Prahova	do.	1,821,962	174,413	202,057	185,985	194,136	186,035	186,122
Dambovitza . . .	do.	291,808	50,737	62,540	76,930	83,641	79,380	90,964
Other fields . . .	do.	160,765	14,370	14,668	13,477	15,784	15,367	15,181
Russia :								
Total production . . .	Long ton	7,500,000	655,000	716,700	726,700	759,000	785,000	747,000
Of which, Baku . . .	do.	4,900,000	441,000	484,096	473,769	515,718	533,620	
Algeria :								
Production	Long ton	1,791	109	115	108	106	109	
Egypt :								
Production	Long ton	175,069	12,159	12,556	16,727	12,810	12,373	16,166
Mexico :								
Production (*a*) . . .	Long ton	16,502,100	1,245,167	1,184,547	1,054,254			
United States (*a*) (*b*) :								
Total production . . .	Long ton	107,978,900	8,569,700	8,936,600	8,820,300	9,270,400	9,503,600	9,328,600
By fields :								
Appalachian . . .	do.	3,895,800	339,900	337,000	349,900	356,700	352,300	351,600
Lima-Indiana . . .	do.	303,000	24,400	25,400	27,900	26,400	25,300	24,400

Michigan	do.	—	—	600	400	700	1,000	1,100
Illinois-S.W. Indiana	do.	1,214,700	90,400	101,000	102,600	105,300	103,400	101,700
Mid-Continent	do.	60,138,000	4,696,300	4,952,500	4,901,400	5,117,700	5,208,400	5,154,300
Gulf Coast	do.	4,494,000	380,700	386,700	362,300	506,600	681,900	687,900
Rocky Mountain	do.	5,055,100	453,400	466,700	466,000	479,400	450,600	421,200
California	do.	32,878,300	2,584,600	2,666,700	2,609,800	2,677,600	2,680,700	2,586,400
By class:								
Light crude, 24° (0·910) and lighter	do.	77,169,700	7,016,600	7,346,000	7,295,000	7,581,700	7,737,000	7,645,200
Heavy crude, heavier than 24° A.P.I.	do.	30,809,200	1,553,100	1,590,600	1,525,300	1,688,700	1,766,600	1,683,400
Argentina:								
Production	Long ton	930,515						
Colombia:								
Production	Long ton	70,000					4,003	
Peru:								
Production	Long ton	1,600,000						
Venezuela:								
Production	Long ton	2,950,856	421,919	413,500	421,400	465,005	430,814	444,722
Dutch East Indies:								
Production	Long ton	3,140,000						
Japan:								
Production	Long ton	237,000						
Persia:								
Production	Long ton	4,578,428						
PHOSPHATES								
BRITISH EMPIRE								
United Kingdom:								
Total imports of phosphate-rock and phosphate of lime	Long ton	338,403	11,687	23,774	18,310	19,740	19,872	16,650
Exports of superphosphates	do.	18,721	1,949	1,074	651	725	2,071	423

(a) *Converted at the rate of 7 barrels = 1 long ton.*
(b) *Figures refer to petroleum transported from the fields The production, including fuel consumed and stocked, was* 109,106,100 *long tons during* 1925.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
PHOSPHATES (*contd.*)								
Canada:								
Imports of phosphate-rock	Long ton	12,502	121	(*a*)	4,503	—	4,484	—
Imports of superphosphates	do.	56,700	6,863	8,082	3,216	4,255	3,101	9,563
Ceylon:								
Imports of superphosphates	Long ton	3,761	246	121	50	230	331	382
New Zealand:								
Total imports of phosphate-rock, superphosphates and fertilisers	Long ton	174,994	16,978	21,475	41,644	22,490	17,838	14,925
Foreign Countries								
Belgium-Luxemburg E.U.:								
Imports of phosphate-rock	Long ton	321,126	29,801	26,384	38,353	23,592	12,882	11,904
Exports of phosphate-rock	do.	65,403	5,448	6,712	6,456	7,144	9,484	11,438
Imports of superphosphates	do.	26,662	3,449	882	117	259	413	1,489
Exports of superphosphates	do.	173,408	30,130	9,987	5,483	10,136	15,954	15,316
Czechoslovakia:								
Imports of phosphate-rock	Long ton	115,380	9,362	23,716	9,692	5,564	1,317	10,497
Imports of superphosphates	do.	14,273	975	98	1,486	2,755	59	3,195
Exports of superphosphates	do.	4,731	3,510	11	375	114	170	238
Denmark:								
Total imports of phosphate-rock	Long ton	124,794	12,625	8,957	7,324	26,104	7,641	19,433
Total imports of superphosphates	do.	144,975	5,223	135	2	—	11,602	17,622
France:								
Production of phosphate-rock	Long ton		449	166	111	—	724	—
Imports of phosphate-rock	do.	1,274,892	131,618	133,678	129,314	157,984	122,282	132,892
Imports of superphosphates	do.	21,927	652	179	77	499	2,814	2,535
Exports of superphosphates	do.	225,676	24,350	9,271	5,941	10,663	26,550	39,806

Germany:								
Imports of phosphate-rock	Long ton	392,954	57,711	31,209	37,805	49,563	22,565	42,503
Imports of superphosphates	do.	39,327	9,266	1,157	2,039	1,012	6,812	8,999
Exports of superphosphates	do.	45,007	9,833	2,820	328	3,826	15,213	4,176
Italy:								
Imports of phosphate-rock	Long ton	823 312	69,477	94,276	76,064	61,960	76,004	80,434
Netherlands:								
Imports of phosphate-rock	Long ton	325,408	24,789	21,838	29,747	26,608	19,725	43,429
Imports of superphosphates	do.	93,131	16,921	3,032	764	1,582	1,869	2,904
Exports of superphosphates	do.	377,257	8,767	31,026	11,338	37,186	55,359	55,919
Norway:								
Total imports of superphosphates	Long ton	21,665	7,029	1,242	10	10	58	—
Russia:								
Production of phosphate-rock	Long ton		3,852					
Sweden:								
Imports of phosphate-rock	Long ton	144,074	3,444	5,121	14,758	20,510	—	5,047
Exports of superphosphates	do.	87,185	3,187	2,528	1,133	10,938	12,239	1,698
Algeria:								
Production of phosphate-rock	Long ton	705,114	70,535	56,830	57,888	67,781	71,450	
Egypt:								
Exports of phosphate-rock	Long ton	65,292	6,472	37,769	8,885	17,217	16,985	3,063
Total imports of superphosphates	do.	54,906	202	—	—	—	—	49
Morocco:								
Sales of phosphates	Long ton	709,100						
Tunis:								
Production of phosphate-rock	Long ton	2,648,000	195,000	188,000	191,000	201,000	198,000	
United States:								
Production of superphosphates	Long ton		266,274	202,917	210,128	228,659	240,185	228,112
Exports of phosphate-rock	do.	870,276	78,350	87,491	64,633	61,942	84,856	56,015
Exports of superphosphates	do.	66,879	5,310	7,902	1,653	2,124	5,238	4,810

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
PLATINUM, &c.								
BRITISH EMPIRE								
Union of South Africa (Transvaal):								
Production of crude platinum	Troy oz.		841	1,052	1,180	1,139	788	970
Sales and shipments of osmiridium	Troy oz.	6,055	390	393	253	639	1,778	300
Canada (Ontario):								
Production of platinum metals	Troy oz.	16,980	(b)3,281	(b)3,281	(b)3,281			
Canada:								
Platinum content of exports of concentrates, etc. . .	Troy oz.	404	44	—	50	51	7	57
Exports of scrap . . .	do.	655	51	—	23	—	11	73
Australia:								
Victoria: Exports overseas of osmiridium	Troy oz	2,004	150	132	151		126	—
Tasmania: Production of osmiridium	do	3,366	(b)242	(b)242	(b)242	(c)388	(c)388	(c)388
FOREIGN COUNTRIES								
United States:								
Production from placers .	Troy oz	343						
Imports of ore (platinum content)	do.		—	18	3	1	—	—
Exports of unwrought platinum	do.	16,234	510	574	1,145	367	174	278
Imports of unwrought platinum	do.	106,478	6,450	15,400	7,062	9,642	14,595	10,645
Imports of iridium, osmium, palladium, etc.	do	14,931	1,443	853	1,873	1,018	1,754	3,273
PYRITES								
BRITISH EMPIRE								
United Kingdom:								
Production in Great Britain, including arsenical pyrites .	Long ton	5,315	(b)197	(b)197	(b)197	(c)193	(c)193	(c)193

Total imports, including cupreous pyrites . . .	do.	275,322	24,069	18,102	6,460	21,970	14,492	17,326
Union of South Africa (Transvaal) :								
Sales and shipments . .	Long ton	2,472	177	181	258	178	145	181
Canada :								
Production	Long ton	13,933	(*a*)1,133	(*a*)1,133	(*a*)1,133			
FOREIGN COUNTRIES								
Austria :								
Production in Styria . .	Long ton	10,843	728	885	828	984	791	1,050
Czechoslovakia :								
Imports of pyrites . .	Long ton	148,196	16,344	24,534	18,850	10,790	3,669	12,359
Imports of pyrites waste .	do.	105,268	10,642	9,537	8,670	9,866	7,500	14,438
Exports of pyrites and waste .	do	1,207	531	335	1,899	—	—	3,153
France :								
Production	Long ton	194,736	15,802	13,608	15,797	15,619	14,662	16,523
Imports	do.	477,362	63,558	33,674	83,141	38,388	54,387	27,422
Germany :								
Imports of pyrites and other sulphur minerals . .	Long ton	917,630	73,096	64,212	62,547	62,395	70,529	66,421
Exports of pyrites and other sulphur minerals . .	do.	11,471	951	451	723	736	712	1,760
Italy :								
Production of iron pyrites .	Long ton	485,870						
Production of cupreous pyrites	do.	39,289						
Imports of iron pyrites . .	do.	193,165	15,585	4,039	28,248	5,934	16,561	5,792
Exports of iron pyrites . .	do.	170,762	2,942	12,410	10,438	15,916	8,640	8,605
Exports of cupreous pyrites .	do.	4,271	—	—	—	—	42	29
Netherlands :								
Imports of iron pyrites . .	Long ton	98,842	3,323	12,085	22,414	16,486	12,697	9,961
Norway :								
Exports of iron pyrites . .	Long ton	94,135	16,496	7,681	4,709	7,976	13,527	19,112
Exports of cupreous pyrites .	do.	435,878	31,230	28,183	24,058	46,103	33,966	53,062

(*a*) *Monthly average of first half-year*, 1926. (*b*) *Monthly average of second quarter*, 1926.
(*c*) *Monthly average of third quarter*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
PYRITES (*contd.*)								
Russia:								
Production of iron pyrites .	Long ton		3,335					
Production of cupreous pyrites	do.		33,922					
Algeria:								
Production of iron pyrites .	Long ton	12,373	850	640	836	986	831	
United States:								
Production of iron pyrites .	Long ton	170,081						
Total imports (containing more than 25 per cent. sulphur) .	Long ton	276,385	6,365	63,351	29,140	50,193	11,849	23,867
QUICKSILVER								
Austria (Tyrol):								
Production	Lb.	13,511	1,100	1,100	1,100	1,300	1,300	1,800
Czechoslovakia:								
Exports	Lb.	22,040	8,816	13,224	4,408	1,763	8,816	11,020
Italy:								
Production	Lb.	4,107,208						
Exports	do.	3,322,310	181,610	370,272	373,137	294,675	271,092	180,728
Rumania:								
Production	Lb.	7,879						
Russia:								
Production of ore . . .	Long ton		2,046					
Mexico:								
Production	Lb.	85,331	11,247	12,182	5,662	8,668	9,933	1,497
United States:								
Production	Lb.	688,050						
SILVER								
BRITISH EMPIRE								
Northern Rhodesia:								
Production	Fine troy oz.	(*a*)5,267	—	12	—	21	—	21
Southern Rhodesia:								
Production	Fine troy oz.	152,705	9,231	9,236	9,553	9,489	9,118	12,696

Union of South Africa (Transvaal):								
Sales and shipments in gold bullion	Fine troy oz.	934,254	80,408	82,373	82,069	86,114	85,157	82,490
Sales and shipments in other minerals	do.	225,815	—	—	—	—	—	—
Canada:								
Production in Ontario	Fine troy oz.	10,217,315 (b)	(c)792,550	(c)792,550	(c)792,550	(e)739,592	(e)739,592	(e)739,592
Silver content of ore, concentrates, etc., exported	do.	4,754,915	117,845	206,483	235,409	1,508,194	919,849	702,858
Silver bullion exported	Troy oz.	14,316,797	1,057,178	1,300,929	1,250,565	828,261	1,709,305	781,503
India (Burma):								
Production	Fine troy oz.	4,831,548	439,337					
Australia:								
Production in:								
Queensland	Fine troy oz.	286,516	(c)29,411	(c)29,411	(c)29,411	(e)21,039	(e)21,039	(e)21,039
Western Australia(d)	do.	59,075	1,689	18,456	23	261	16,421	239
Tasmania	do.	730,194	(c)54,317	(c)54,317	(c)54,317	(e)82,811	(e)82,811	(e)82,811
Commonwealth	do.	8,638,416						
New Zealand:								
Exports of silver	Troy oz.	495,268	43,287	35,928	77,952	49	17,277	37,512
PRODUCTION IN FOREIGN COUNTRIES								
Germany:								
Production	Troy oz.	4,501,000						
Italy:								
Production	Troy oz.	525,336						
Cuba:								
Production	Fine troy oz.	91,916						
Mexico.								
Production	Fine troy oz.	92,885,176	8,839,096	7,996,766	8,401,245	6,979,765	6,133,995	7,631,928

(a) *Including an adjustment for the period* 1920-1924 *inclusive.* (b) *Production in the Dominion during* 1925 *was* 20,228,988 *fine troy ounces.*
(c) *Monthly average of second quarter,* 1926. (d) *Silver content of bars, slag, etc., exported from the State, not necessarily overseas.*
(e) *Monthly average of third quarter,* 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
SILVER (*contd.*)								
United States:								
Production	Fine troy oz.	66,106,922	4,954,000	5,066,000	5,211,000	4,673,000	5,270,000	4,995,000
Bolivia:								
Quantity of ore exported	Cwt.	223,214	20,665	11,120	34,286	9,373	18,655	13,960
Silver content of ore exported	*Troy oz.*		*574,038*	*407,855*	*597,861*	*500,929*	*557,385*	*474,341*
Chile:								
Exports of ore	Cwt.	15,023	961	34	1,932	514	14	2,499
Exports of silver bullion	Troy oz.	300,828	13,834	33,321	—	40,684	—	21,911
Ecuador:								
Production	Fine troy oz.	78,000						
Peru:								
Production	Fine troy oz.	20,888,400						
Exports of:								
Ore (*a*)	Cwt.	14,576	390	1,604	1,340	1,960	516	3,038
Concentrates (*a*)	do.	104,179	10,239	17,030	7,744	1,785	24,668	3,175
Sulphides (*a*)	do.	888	65	43	111	134	11	84
Silver bullion	Troy oz.	790,922	135,930	965	196,308	2,058	2,025	143,292
Silver scrap	do.	2,122	—	—	—	643	—	—
Japan:								
Production	Fine troy oz.	5,665,000						
SULPHUR								
BRITISH EMPIRE								
United Kingdom:								
Total imports	Long ton	109,545	8,876	3,523	7,753	6,943	1,368	3,488
Canada:								
Imports	Long ton	130,902	2,510	4,483	35,412	15,259	9,718	19,622
India:								
Total imports from overseas	Long ton	12,337	1,276	338	1,720	822	714	1,174
New Zealand:								
Total imports	Long ton	19,982	2,769	4,513	46	1,007	4,713	12

Foreign Countries								
Belgium-Luxemburg E.U.:								
Imports	Long ton	9,288	596	1,257	1,941	421	393	869
Exports	do.	3,345	519	666	265	142	334	125
Czechoslovakia:								
Imports	Long ton	4,846	568	443	711	191	283	482
Finland:								
Total imports	Long ton	32,024	448	4,129	4,940	1,666	4,967	3,529
France:								
Imports of crude sulphur	Long ton	446,326	50,102	33,505	42,534	40,202	32,205	29,400
Exports of crude sulphur	do.	13,820	1,829	530	651	873	1,196	8
Exports of refined sulphur	do.	16,523	1,856	1,724	840	981	338	168
Germany:								
Imports	Long ton	103,817	7,460	7,185	5,090	2,369	7,084	626
Exports	do.	56,818	2,441	3,694	6,934	7,840	10,473	4,413
Italy:								
Production of crude fused sulphur	Long ton	259,355						
Production of crude ground sulphur	do.	26,813						
Exports of crude lump sulphur	do.	94,323	20,027	9,183	18,649	15,606	5,010	1,809
Exports of crude ground sulphur	do.	18,466	3,267	2,578	60	11	217	
Exports of refined lump sulphur	do.	33,735	806	1,214	645	816	1,134	650
Exports of refined ground sulphur	do.	32,530	3,159	3,901	1,322	477	962	330
Exports of flowers of sulphur	do.	8,132		794	326	377	234	278
Norway:								
Total imports	Long ton	15,292	500	1,361	1,413	667	1,683	1
Sweden:								
Imports	Long ton	62,273	1,537	9,730	10,438	4,523	6,870	5,576
United States:								
Production	Long ton	1,409,240						
Exports of sulphur	do.	629,401	42,009	30,304	50,098	19,540	61,012	40,011
Exports of flowers of sulphur	do.	2,849	407	437	282	365	574	311

(a) *Silver is also contained in ores of base metals exported.*

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
SULPHUR (*contd.*)								
Japan:								
Production of sulphur rock	Long ton	46,000						
TIN								
British Empire								
Great Britain:								
Tin content of ore produced	Long ton	2,348	(*a*)183	(*a*)183	(*a*)183	(*e*)202	(*e*)202	(*e*)202
Total imports of ores and concentrates	do.	64,124	6,497	4,103	4,943	6,100	5,360	3,647
Re-exports of ores and concentrates	do.	256	—	—	—	—	188	426
Exports of blocks, ingots, etc.	do	25,758	1,388	2,456	3,082	2,471	2,391	2,497
Total imports of blocks, ingots, etc.	do.	15,919	1,351	599	1,156	698	951	803
Re-exports of blocks, ingots, etc.	do.	9,457	1,261	367	468	760	286	509
Nigeria:								
Approximate tin content of ore produced	Long ton	5,991	481	512	568	606	935	803
Southern Rhodesia:								
Tin content of ore produced	Long ton	17	—	5	—	—	—	8
South-West Africa Territory:								
Exports of ore	Long ton	218	30	16	22	14	22	
Swaziland:								
Production	Long ton	194						
Union of South Africa (Transvaal):								
Tin content of marketable products	Long ton	1,157	97	97	82	90	103	102
Federated Malay States:								
Total tin content of exports	Long ton	45,925	3,667	3,692	4,074	4,086	3,766	3,899
By class:								
Tin in ore	do.	38,567	2,628	3,193	3,614	3,661	3,301	3,483
Tin	do	7,358	1,039	499	460	425	465	416

By State :								
Perak	do.	30,748	2,445	2,456	2,653	2,675	2,556	2,637
Selangor	do.	13,104	1,108	1,061	1,257	1,190	1,030	1,125
Negri Sembilan . . .	do.	3	—	—	(c)	—	—	—
Pahang	do	2,070	114	175	164	221	180	137
India :								
Tin content of ore produced .	Long ton	1,616						
Exports of tin ore overseas .	do.	1,887	96	84	131	167	87	151
Exports of tin overseas .	do.	353	50	50	106	—	73	123
Australia :								
Tin concentrates produced in (b) :								
Queensland :								
Lode	Long ton	674	(a)55	(a)55	(a)55	(e)72	(e)72	(e)72
Alluvial.	do.	335	(a)27	(a)27	(a)27	(e)25	(e)25	(e)25
Tasmania (tin content) .	do.	1,130	(a)73	(a)73	(a)73	(e)98	(e)98	(e)98
Western Australia (d) .	£	15,392	—	1,580	—	1,120	900	2,750
Exports of refined tin overseas from :								
New South Wales . .	Long ton	1,560	51	86	65		183	227
Victoria	do.	188	—	—	—		—	5
Exports of tin clippings overseas from :								
New South Wales . .	do.	1,036	267	360	220		67	312
Victoria	do	2,264	165	266	150		161	240
Queensland	do.	349	101	41	168	116	44	44
South Australia . .	do.	28	—	17	15		27	19
Foreign Countries								
Belgium-Luxemburg E.U. :								
Imports of ore	Long ton	1,369	115	30	(c)	—	22	281
Imports of unwrought tin and scrap	do.	1,128	123	66	98	78	59	60

(a) *Monthly average of second quarter*, 1926.
(b) *Tin content of ore produced in the Commonwealth during* 1925 *was* 3,016 *long tons ; smelter production was* 3,171 *long tons.*
(c) *Less than ½ ton.* (d) *Exports, not necessarily overseas.* (e) *Monthly average of third quarter*, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
TIN (*contd.*)								
Belgium-Luxemburg E.U. (*contd.*):								
Exports of unwrought tin and scrap	Long ton	748	59	119	207	88	61	66
Czechoslovakia:								
Imports of crude tin, tin alloys and scrap	Long ton	1,516	94	128	73	65	114	150
France:								
Production of tin-tungsten ore	Long ton	1,658	325	164	513	707	626	763
Germany:								
Imports of ore	Long ton	1,677	25	19	109	566	993	1,231
Imports of crude tin and scrap	do.	12,736	560	636	1,010	834	893	1,082
Exports of crude tin and scrap	do.	2,725	384	307	331	403	282	423
Exports of tin-foil	do.	257	58	30	29	27	25	26
Netherlands:								
Imports of crude tin and scrap	Long ton	1,174	91	59	99	41	47	76
Belgian Congo:								
Production of tin ore	Long ton	1,500						
United States:								
Total imports of bar, block or pig tin	Long ton	76,646	5,912	6,159	7,230	7,941	5,132	6,092
Re-exports of bar, block or pig tin	do.	570	102	173	36	145	94	124
Exports of bar, block or pig tin	do.	362	46	48	38	30	58	66
Bolivia:								
Exports of ore	Long ton	53,457	4,282	4,170	4,561	4,680	3,560	5,231
Tin content of ore exported	*do.*	*31,500*	*2,553*	*2,410*	*2,638*	*2,636*	*2,023*	*2,920*
China:								
Tin content of shipments (*a*)	Long ton	7,421	(*b*)1,227	(*b*)223	(*b*)125	(*b*)72	(*b*)85	(*b*)76
Dutch East Indies:								
Tin content of ore produced	Long ton	32,749						
Shipments of Banca tin (*a*)	do.	14,177	1,629	2,423	691	1,030	1,101	1,488

French Indo-China :								
Exports of tin-tungsten ore .	Long ton	464	40	62				
Exports of tin ingots . .	do.	321	15	46				
Siam :								
Tin content of ore produced .	Long ton	8,062						
ZINC								
BRITISH EMPIRE								
United Kingdom :								
Zinc content of ore produced .	Long ton	738	(d)51	(d)51	(d)51	(e)63	(e)63	(e)63
Smelter output	do.	42,000	(c)2,500	(c)2,500	(c)2,500			
Exports of spelter and wrought zinc, etc.	do.	5,393	358	376	588	802	487	255
Total imports of spelter .	do.	135,783	11,118	10,414	11,269	12,794	12,543	10,681
Total imports of wrought zinc, etc.	do.	18,410	1,549	1,146	1,602	1,543	2,039	1,724
Re-exports of spelter . .	do.	7,663	802	17	166	84	622	70
Northern Rhodesia :								
Smelter output . . .	Long ton	211	—	—	—	—	—	—
Canada :								
Zinc content of ore produced .	Long ton	48,780	(c)4,997	(c)4,997	(c)4,997			
Exports of ore . . .	do.	43,161	—	—	2,330	1,432	9,136	9,223
Smelter output . . .	do.	34,358	4,623	4,874	4,496	4,488	5,004	4,304
Exports of spelter . .	do.	22,244	2,580	3,799	2,318	4,386	3,768	3,811
India :								
Production of concentrates in Burma	Long ton	16,600	(d)4,323	(d)4,323	(d)4,323			
Exports of spelter, etc., overseas	do.	20,967	4,020	1,000	8,500	3,800	4,814	2,000
Total imports of spelter, etc., from overseas . . .	do.	6,606	966	894	486	996	1,074	642

(a) From 26th of previous month to 25th of month stated.
(b) To United Kingdom and United States only.
(c) Monthly average of first half-year, 1926.
(d) Monthly average of second quarter, 1926.
(e) Monthly average of third quarter, 1926.

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
ZINC (*contd.*)								
Australia :								
Zinc content of ore produced in (*a*) :								
Queensland . . .	Long ton	171	—	—	—	—	—	—
Tasmania	do.	3,113	(*b*)291	(*b*)291	(*b*)291	(*c*)764	(*c*)764	(*c*)764
Exports overseas of ore, etc., from :								
Queensland (ore) . .	Long ton	462	121	—	—		—	—
South Australia (concentrates)	do	181,844	31,180	23,706	34,183		41	23,424
Smelter output in :								
Tasmania	Long ton	42,976	(*b*)3,868	(*b*)3,868	(*b*)3,868	(*c*)3,222	(*c*)3,222	(*c*)3,222
Commonwealth . . .	do.	45,698	3,870	3,999	3,860	4,139	4,092	3,960
Exports of spelter overseas from :								
New South Wales . .	Long ton	2,864	1	—	—		1	1
Tasmania	do.	24,361	3,400	2,450	1,375		2,000	3,400
FOREIGN COUNTRIES								
Austria (Carinthia) :								
Production of ore . . .	Long ton	1,402	182	335	137	152	38	50
Belgium :								
Smelter output . . .	Long ton	168,114	15,418	15,520	15,280	15,510	15,940	15,660
Belgium-Luxemburg E.U. :								
Imports of ore . . .	Long ton	503,948	38,345	59,747	81,185	35,374	50,890	98,238
Exports of ore . . .	do.	21,749	3,665	1,158	6,097	3,255	3,364	5,743
Imports of spelter and scrap .	do.	7,924	243	509	235	185	324	362
Exports of spelter and scrap .	do.	81,057	8,430	5,067	8,158	4,997	8,565	8,087
Imports of sheets . .	do.	160	11	17	11	11	2	11
Exports of sheets . . .	do.	47,973	3,993	3,393	4,406	3,336	4,670	4,051
Czechoslovakia :								
Imports of ore . . .	Long ton	3,146	647	—	—	870	—	(*d*)

Exports of ore	do.	1,707	—	—	39	256	39	—
Imports of spelter and scrap .	do.	16,069	1,015	529	1,037	809	1,392	1,153
France (c) :								
Production of ore . . .	Long ton	14,528	1,368	935	1,539	1,174	1,395	973
Imports of ore . . .	do.	167,718	17,002	22,837	22,183	14,386	11,141	9,719
Exports of ore . . .	do	23,034	873	1,717	576	717	889	151
Imports of spelter, sheets and scrap	do.	45,628	3,175	5,869	3,051	3,797	3,833	3,026
Exports of spelter, sheets and scrap	do.	19,412	826	741	708	1,140	2,315	2,293
Germany :								
Imports of ore	Long ton	90,903	5,636	8,546	18,974	24,727	13,132	13,480
Exports of ore	do.	72,443	5,715	4,975	6,587	8,726	10,703	11,507
Smelter output	do.	57,705	5,092	5,485	5,471	5,743	5,829	5,854
Imports of spelter, dust, sheets, wire and scrap	do.	133,560	7,708	9,143	10,674	8,902	13,559	12,231
Exports of spelter, dust, sheets, wire and scrap	do.	26,662	1,726	1,800	1,914	1,923	2,394	1,713
Italy :								
Zinc content of ore produced .	Long ton	67,779						
Exports of ore	do.	171,578	3,545	21,869	13,571	19,842	12,912	19,532
Smelter production . .	do	6,374						
Imports of ·spelter, sheets, plates and scrap . .	do.	18,140	1,917	1,741	1,478	976	824	1,086
Netherlands :								
Imports of ore	Long ton	106,649	12,167	6,690	7,603	10,166	9,019	11,802
Imports of spelter and scrap .	do.	3,237	287	321	423	178	406	339
Exports of spelter and scrap	do.	24,904	2,150	1,900	1,809	1,870	2,292	3,300
Imports of sheets, wire and dust	do.	7,244	767	918	730	992	867	847
Exports of sheets, wire and dust	do.	1,109	52	103	96	140	172	101
Russia (c) :								
Production of concentrates .	Long ton		782					

(a) *Zinc content of ore produced in the Commonwealth during 1925 was 138,783 long tons.* (b) *Monthly average of second quarter, 1926.*
(c) *See also under "Lead."* (d) *Less than ½ ton.* (e) *Monthly average of third quarter, 1926.*

Particulars.	Unit.	Year 1925.	April 1926.	May 1926.	June 1926.	July 1926.	August 1926.	September 1926.
ZINC (*contd.*)								
Upper Silesia :								
Production of ore	Long ton	313,576	27,183	25,395				
Smelter output	do.	89,487	8,233	8,528	8,353	8,758	8,750	8,508
Algeria :								
Production of ore	Long ton	47,391	4,818	5,131	4,953	3,794	3,433	
Tunis :								
Production of ore	Long ton	19,196	1,968	2,164	1,820	2,066	2,361	
Mexico :								
Zinc content of ore produced	Long ton	45,034	11,396	9,407	8,840	8,670	8,096	6,609
Smelter output	do.	1,255	510	494	400	435	515	496
United States :								
Zinc content of ore produced	Long ton	636,000						
Shipments of Joplin ore	do.	726,074	57,788	61,355	49,761	65,535	60,479	62,095
Total imports of ore	do.	12,086	1,001	128	452	917	139	638
Exports of ore and dross	do.	75,874	20,996	6,727	12,437	5,002	6,592	5,846
Smelter output	do.	511,559	47,619	47,950	43,059	43,217	46,215	46,557
Exports of spelter, dust, sheets, etc.	do.	73,919	3,202	2,795	5,426	5,537	3,913	5,145
Bolivia :								
Exports of ore	Long ton	6,110	506	534	3,132	2,668	2,897	686
Zinc content of ore exported	*do.*		*253*	*254*	*1,275*	*1,091*	*1,204*	*326*
French Indo-China :								
Exports of ore	Long ton	49,163	3,338	6,237				

VOL. XXIV, 1926

INDEX

Botanical names and titles of books are printed in italics and authors' names in capitals